Effect of Velocity on Horse Mussel Initial Feeding Behavior

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ABSTRACT

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Laboratory flume experiments to determine the effect of velocity on the initial feeding responses of the horse mussel, *Modiolus modiolus* (Linnaeus, 1758), are described. Two independent ways of measuring feeding behavior in a flow range of 12-63 $cm \cdot s^{-1}$ were employed. The first involved repeated observations of the exhalant siphon opening area, which is assumed to indicate the ciliary pump exhaled seawater output, following filtration at the gill surface. The second measure attempted to assess seston depletion in a fixed volume flume by fluorometric determination of chlorophyll a in flume seawater, as well as by microscopic determination of cell density. Some mussels did not pump and others only partially opened for filtration during our experiments, resulting in the fluorometric method being unable to resolve the smaller than expected differences between initial and final concentrations in hour-long experiments. Inhalant and exhalant siphons remained open throughout the flow range tested, although the exhalant siphon area had been reduced to ~20% of the maximum possible at 55 $cm \cdot s^{-1}$.

RÉSUMÉ

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Sont décrites des expériences de laboratoire en forme de canal venturi dans le but de déterminer l'effet de la vélocité sur les réactions initiales d'alimentation du modiole ou de la grande moule du Nord, *Modiolus modiolus* (Linnaeus, 1758). Pour ce faire, on a utilisé deux moyens distincts de mesurer le comportement d'alimentation dans une plage de débit de 12-63 $cm \cdot s^{-1}$. Le premier comportait des observations répétées de la zone d'ouverture du siphon exhalant qui, présume-t-on, reflète l'eau de mer expulsée par la pompe ciliaire après la filtration au niveau des nageoires. Le deuxième moyen tentait d'évaluer le taux d'épuisement du seston dans un canal à volume constant par détection fluorimétrique de la chlorophylle contenue dans un canal d'eau de mer ainsi que par la détermination microscopique de la densité cellulaire. Au cours de nos expériences, certaines moules n'ont aspiré aucune nourriture et d'autres n'ont que partiellement ouvert le siphon pour la filtration si bien qu'il n'a pas été possible grâce à la détection fluorimétrique de faire la distinction entre les différences plus légères que prévu entre les concentrations finales et initiales de seston au cours des expériences d'une heure. Les siphons inhalants et exhalants sont demeurés ouverts tout au long de la plage de débit examinée bien que la zone du siphon exhalant ait été réduite de ~20 % du maximum possible à 55 $cm \cdot s^{-1}$.

INTRODUCTION

The initial feeding behavior/physiology responses of bivalves includes the transport of seawater past the filtration surfaces and capture of seston as defined by Wildish and Kristmanson (1997). The importance of initial feeding is that it is the only response influenced by environmental factors such as velocity and seston concentration/ quality.

The horse mussel, *Modiolus modiolus* (Linnaeus, 1758), which is the subject of this study, is an active suspension feeder. We suppose that its ciliary pump is similar to that of the blue mussel, *Mytilus edulis*, studied by Jørgensen et al. (1986a, b) so elegantly. Although a number of hypotheses have been proposed to explain the capture of seston on the gills of bivalves (Jørgensen 1981; Ward et al. 1998; Riisgard and Larsen 2000), no agreement on the precise mechanism has been reached (Riisgard and Larsen 2000). Observational methods using video endoscopy (Ward et al. 1998) or microscopy (Riisgard and Larsen 2000), as used in recent work, have not been reconciled with the relevant physical aerosol theory introduced to this field by Rubenstein and Khoel (1977).

Our purpose was not to further the mechanistic study of initial feeding behavior/ physiology in the horse mussel as outlined in the above, but to use what is known about bivalve initial feeding responses in an attempt to solve an ecological question. The question arose from field work in the Bay of Fundy (Wildish et al. 1998a; Wildish and Fader 1998; Wildish et al. 1998b) and was: "Why do some populations of horse mussels there grow faster than others?" It was found (Wildish et al. 1998b) that populations of horse mussels living in the sand with bioherm geological province, where they formed raised mussel reefs, grew at faster rates than those on other geological provinces, e.g. gravel cobble, mottled gravel and glacio-marine mud. As pointed out by Wildish et al. (1998b), multiple limiting factors could be involved in the answer to this question. Our purpose here was to examine one limiting factor hypothesis related to the question above.

Formally stated, the null hypothesis was that tidal and/or wind-wave induced flows inhibit initial feeding as they do in some other bivalves, e.g. in blue mussels (Wildish and Miyares 1990) and scallops (Wildish et al. 1992). Then, flow inhibition on mussel reefs in the sand with bioherm province would be presumed to be less than on other substrates. The alternate hypothesis is that flow velocity has little effect on initial feeding, and that other limiting factors must be sought.

Our emphasis on environmental limiting factors, rather than internally controlled genetic ones, seems justified in view of the likely short geological period (~8000 yr BP) that horse mussels have been present in the Bay of Fundy. The environmental conditions in this Bay during the post-glacial period have been constructed from geological data (Fader et al. 1977).

MATERIALS AND METHODS

Horse mussels were collected at Sandy Point, St. Croix estuary (45°08.4'N, 67°08.1'W) on 25 October 1999 at extreme low water springs, which occurred at 1755 AST. The byssus threads that connected the mussels to rocks and stones were cut with a sharp knife and mussels placed in a bucket for transfer to the laboratory. Within an hour, the 40 mussels selected had been transferred to running seawater in the laboratory.

CULTURE OF MUSSELS

The mussels were placed in plastic mesh trays in a circular tank (1 m diameter), plumbed with a central standpipe at 0.5 m above the tank floor (volume capacity = 292 L). Within days of capture, each mussel was identified by a small numbered tag attached to the anterior part of the valve by Crazy Glue. Valve dimensions (see Fig. 1) were recorded for each mussel at the end of the experiments. A Little Giant submersible pump (300 gal$\cdot$h^{-1} capacity) at the bottom of the tank kept the seawater moving around the tank at all times. Mussels were fed daily, except on weekends, on equal quantities of the microalgal cultures (300-500 mL of each) after stopping the flow to the tank. Feeding was for 4-6 h before the filtered seawater supply was restored. Volumetric flows through the stock tank were 18 L$\cdot$min^{-1} and fluorometric backgrounds ranged from 50-150 arbitrary fluorescence units, equivalent to 1000-4000 cells$\cdot$mL^{-1} of mixed microalgal culture. Natural photoperiod was simulated in the laboratory in which the mussels were kept and temperatures of lab air maintained around +17°C.

MICROALGAL CULTURE

Microalgal cultures were grown by standard methods as in Guillard (1984), using filtered seawater medium enriched with f/2. The medium was added to local seawater of a salinity of ~30 PSU. Cultures

were maintained at 14°C and a 14-h light period. The light intensity offered was 40 $\mu E \cdot m^{-2} \cdot s^{-1}$. Two strains were cultured, *Isochrys* sp., T-ISO (Tahitian) and *Chaetoceros calcitrans* (Atlantic). Cell densities at the stable growth phase were determined for each batch culture by microscopic counts using a haemocytometer.

EXPERIMENTAL FLUME

All experiments were conducted in a Saunders-Hubbard recirculating flume as described by Wildish and Saulnier (1993) and Wildish et al. (1998c). Because of a software problem, the automatic capturing of flow and temperature data was not possible. Instead, these were recorded by an observer from digital displays in the laboratory. Volume capacity of the flume is 205 L. A Nixon Stream Flo probe was suspended 20 cm in front of, and at the level of, the siphons of the most upstream mussel. It was calibrated against an independent acoustic flow device (PVM) and the results expressed as $cm \cdot s^{-1}$. The temperature probe was suspended at mid depth and just behind the Stream Flo probe.

A standard volume of 300 mL of each of the two microalgal cultures was added to the flume and the cell densities estimated from the straight-line relationship between chlorophyll a, determined by fluorometry, and batch culture microscopic counts.

EXHALANT OPENING

Paired inhalant and exhalant openings are found side by side at the posterior end of the mussel (Fig. 1). The exhalant opening was often ovoid in shape, although it could also be slit-like, lobed at one end, or with extensible lips of a few millimeters in height and with a serrated edge. The mussel could also rapidly close or open both siphons.

The valve gape was measured as the distance between right and left valve at its maximum point. If the gape was open wide enough, it was possible to see the soft tissue exhalant opening and measure it as its length (l) and height (h) as in Fig. 1. Acrylic posts marked in 1-mm grid lines were glued to the flume floor near each mussel, as guides for estimating dimensions. The exhalant area was calculated as the oval:

$$4/3\ \pi\ (l \times h)/2 \qquad (1)$$

although, as mentioned, it was sometimes irregular in shape. We were unable to account for the curvature of the exhalant area in making these measurements.

PRELIMINARY EXPERIMENTS

Groups of three horse mussels were fitted with 2 x 1-cm pieces of Velcro, glued with Crazy Glue, directly onto the cleaned valve. For an experiment, the numbered mussel was removed from the acclimation tank (involving cutting byssus threads) and attached to corresponding pieces of Velcro glued to the flume bottom. Approximate measurements were made by an observer, as outlined above, at 15-min intervals. Various velocities were tried and mixtures of the two microalgal cultures (at cell densities in the flume of ~7 x 10^3 $cells \cdot mL^{-1}$ of each) and suspended sediment from the seawater supply lines in order to optimize filtration rates of the mussels. Each experiment lasted for 2-4 h and its purpose was to determine the maximum exhalant opening area for each individual. A total of 18 mussels were tested on two-five separate occasions.

DEFINITIVE EXPERIMENTS

In the final form of the experiments, we placed three mussels on a specially made, 5-mm thick plastic plate (see Fig. 2) using Velcro attachments to valve and plate. The mussels could be transferred to and from the flume firmly attached to the plate, and it was then not necessary to cut the byssus threads for each experiment. In this way each animal became firmly attached to its own plate with its own byssus. The nine most active mussels of the previous experiment were prepared in this way with a 10-d period before the experiment began. Each plate had the upstream face bevelled in order to smoothly deflect flow, and could be slid into supports screwed to the flume floor.

An experiment was begun by filling the flume with re-filtered seawater (Cuno 5-µm, cut-off filter) taken from the Biological Station pumped supply. Blank samples were taken to determine the Chla content by fluorometry. 500-mL aliquots of each microalgal culture were then added, followed by sampling for fluorometry. After 1 h and at the same starting velocity for that experiment, further samples were taken before adding the mussel plate. Thereafter, fluorescence readings were taken at the end of each hour until the end of the experiment. Flow rates were increased or decreased in steps at the end of each hour.

Three separate seawater samples of 100 mL were removed from the flume (just above the propeller) to determine chlorophyll a by fluorometric method as in Wildish et al. (1998c). After filtration on a Whatman GFC filter, to which $MgCo_3$

suspended in water was added, the filter was extracted with 90% acetone (10 mL) overnight in the dark at 0°C. After centrifuging, the supernates were read in a Model 10-AU-005 Turner Designs fluorometer, set up with 1-cm path length cells and read as arbitrary units against a 90% acetone blank. The fluorometer readings were related to cell densities determined microscopically.

An observer was present throughout each experiment and recorded valve gape, exhalant siphon opening height and width for each mussel, air and water temperatures and velocity in hertz from the Stream Flo rotor at 5-min intervals. At the end of the experiments, wet and dry weights for all 40 of the mussels were determined by drying for 48 h in a convection oven at 85°C.

ANALYSES

Means and standard deviations were calculated for temperature and velocity as hertz, and the latter expressed as U, $cm \cdot s^{-1}$ by:

$$\text{Probe 1 } cm \cdot s^{-1} = 0.4922 \text{ Hz} + 5.6434, \quad R^2 = 0.97 \quad (2)$$

or

$$\text{Probe 2 } cm \cdot s^{-1} = 0.4757 \text{ Hz} + 5.887, \quad R^2 = 0.98 \quad (3)$$

derived from a recent calibration between the PVM acoustic velocimeter and each probe.

Straight-line relationships between cell density and chlorophyll a content were used to express microalgal concentration as cell density.

The following behavioral measures were based on the periodic observations made during an experiment:

- number of times valves opened and closed per hour, and
- exhalant opening area - it was assumed, for purposes of calculation, that the area remained constant in the 5-min period preceding the observation. Then the total area open (mm^2) in that hour could be calculated and compared to the maximum observed in the preliminary experiments, assuming that it was maintained for the full hour.

The filtration rate, R, was determined as $L \cdot h^{-1}$ per group of three horse mussels in each experiment, assuming that filtration efficiency, RE, was 100%. Microalgal cell size of both cultures was ~5 µm. The measurement of chlorophyll a fluorometrically was converted to cell density from calibration graphs of the mixed microalgal cultures added to the flume. Filtration rate was calculated from Coughlan's formula:

$$R = V/T \ln (C1/C2) \quad (4)$$

where V = volume of flume in L (205), T = time in hours, C1 = initial and C2 = final cell density at the end of each hour in $cells \cdot L^{-1}$. Control experiments were calculated in the same way.

RESULTS

BIOMETRY

Using valve length (x) as the baseline measurement, valve height (y_1) and valve width (y_2) were related as follows:

$$y_1 = 0.4763x + 5.4144, \quad n = 39, \quad r^2 = 0.85 \quad (5)$$

and

$$y_2 = 0.4147x + 0.4132, \quad n = 39, \quad r^2 = 0.76 \quad (6)$$

The wet weight of tissues (y_3) was related to valve length (x) as follows:

$$y_3 = 0.4726x + 21.019, \quad n = 39, \quad r^2 = 0.85 \quad (7)$$

and dry weight of tissues (y_4) related to valve length (x) by:

$$y_4 = 0.0891x - 3.8178, \quad n = 39, \quad r^2 = 0.83 \quad (8)$$

The original data for these equations is shown in Appendix 1.

PRELIMINARY EXPERIMENTS

We observed that some of the mussels did not open and begin feeding either during acclimation in the holding tank or during experiments in the flume. We identified two variables inimical to mussel feeding: murky water (e.g. due to line back-flushing), or cutting of byssus threads. We were able to acclimate the mussels to the holding tank conditions. Typically, 20-80% of the mussels could be seen to be filtering during the feeding period with mixed microalgal cultures.

The objective of the preliminary experiments was to determine the maximum exhalant area - presumed to indicate the maximum pumping

rate - for each individual mussel. A subgroup of 18 mussels was prepared for this and tested two to five times in the flume to determine the maximum dimensions of the exhalant opening.

The linear relationship between valve height (x) and maximum observed exhalant area (y_5) was forced through zero, yielding:

$$y_5 = 2.0278x - 0.8532, \quad n = 5, r^2 = 0.99 \quad (9)$$

This equation was used to predict the maximum exhalant area for all mussels in the following experiments.

DEFINITIVE EXPERIMENTS

This work is based on controls (without mussels) and eight experiments with three mussels per plate. Each experiment lasted for a 6-h period, with mussel behavioral observations not begun until the second hour.

It was not possible to see the exhalant opening clearly unless the valves were open to >2-3 mm; nevertheless, we have defined closing as complete valve closure. This means that there is a lower boundary when the valve gape was open 1-3 mm but the exhalant area could not be determined.

Effect of flow on valve opening

We made 12 behavioral and environmental observations at 5-min intervals each hour during definitive experiments. Observations were made on each of the three mussels present on an experimental plate.

Results (Appendix 2) show that the valve gape opened or closed up to eight times during the hour-long experiments. A total of 68 valve opening/closing events were recorded during a total period of 40 h observing three mussels. Some of these valve gape changes were clearly stimulated by changes in flow velocity. Of these, six were associated with increase, and four with decrease in flow velocity. It should be noted that our observations were not made at the time of velocity change, but approximately 4-5 min later. Thus, our observations are a conservative measure of velocity on valve gaping.

Effect of flow velocity on exhalant siphon area

Results (Table 1, Appendix 3) of the 5-h long experiments, with 1 h for acclimation, suggest a unimodal response of the exhalant siphon area. This is demonstrated by the response of single horse mussels to flow as shown in Fig. 3. We noted that in the earlier runs of this experiment at U <34 $cm \cdot s^{-1}$ and where either consistent increases or decreases of flow every hour were offered, the response pattern to flow was different. This suggestion of a hysteresis effect is clearly shown in Fig. 3. In later runs of this experiment, e.g. experiment 9, where U_{max} = 55 $cm \cdot s^{-1}$ and consistent increases (U = 23-55 $cm \cdot s^{-1}$) were offered, the response is again unimodal (Fig. 4), with U_{max} clearly inhibitory to exhalant siphon opening.

Of a total of eight experiments with three horse mussels in each, the predicted maximum exhalant siphon area was reached on only three occasions (Table 1). From a possible 24 exhalant siphon openings, 15 openings (63%) were obtained during the experiments, and this compares favorably with the observed acclimation tank siphon openings.

Increases in the temperature of flume seawater during the 5-h long experiments were due to the differential temperature between the seawater supply (6-7°C) and the flume laboratory air temperature (17-18°C). Flume seawater temperature increased by ~2°C during the longer experiments (Appendix 3) and by 0.5°C during the shorter, 1-h long experiments (Appendix 5).

Effect of flow velocity on filtration rate, R

Control experiments in which mussels were absent were included to measure:

1) possible passive losses of microalgae during the 1-h long experiments, e.g. due to sedimentation;

2) possible increases in chlorophyll a content, e.g. due to microalgal resuspension; and

3) chlorophyll a measurement reproducibility due to sampling and fluorometric determination variances.

Control experiment data for C1 and C2 were calculated in the same way as in mussel experiments and results are shown in Appendix 7. R_{blank} results were highly variable with both positive and negative values, signifying both increases and decreases of microalgae. The control data suggested that microalgal sedimentation and resuspension are controlled by flume speed. The mean R_{blank} from Appendix 7 is -0.25% and we have not corrected measured mussel filtration rates with it, due to the

conflicting results. R values of Appendices 4 and 6 have only been corrected by apportioning the total R value between the active filtering mussels, based on the exhalant siphon area contributed by each mussel.

Corrected filtration rate data are shown in Appendix 4, which also includes the total exhalant siphon area open during each hour of the experiment, as well as this value calculated as a percentage of the maximum, presuming that the predicted maximum siphon area was open throughout the experiment. Fluorometric data were not available for the first two experiments. In experiment 3, the single mussel feeding, #2608, had a unimodal response in both R and exhalant siphon area (Fig. 5), suggesting that they were linked cause-effect responses. However, in none of the rest of the data of Appendix 4 was this the case.

We plotted all of the filtration rate data in Appendix 4 as a function of velocity (Fig. 6). The results suggest that the filtration rate is an inverse function of velocity with an upper cutoff in R at >55 $cm \cdot s^{-1}$. Any R values shown > 13 $L \cdot h^{-1}$ are probably artifactual.

Confirmatory experiments

Because of the suspected hysteris effect in the definitive experiments, we undertook a further series of experiments similar to the above, except that no changes of flume flows were made during them.

The protocol employed was as follows. Following the addition of 300 mL each of TISO and *C. calcitrans*, 30 min was allowed for flume mixing. A new plate of three mussels was then placed on the flume floor and mussels allowed to acclimate for 2 h. Seston concentrations were measured fluorometrically at the beginning, C1, and end, C2, of each hour-long experiment in five replicate samples of flume seawater. During the hour-long experiments, gaping and exhalant area observations were made at 5-min intervals as before.

The results of the confirmatory experiments are shown in Table 2 and Appendix 6. In addition to the results shown there, two control experiments without mussels are included in Appendix 7. From Table 2 it can be seen that only one or two of the mussels were filtering during the experiment. In addition, the maximum siphon area observed, 57%, suggests that the experimental conditions did not encourage uninhibited filtration by the mussels. As in the definitive experiment, the low filtration rates of the mussels means that the small C1-C2 differences cannot be resolved by the fluorometric method.

DISCUSSION

Filtration rates, R, of horse mussels, *Modiolus modiollus*, have been estimated from the difference between seston concentrations in inhalant and exhalant flows collected directly from a maximally pumping animal (Mohlenberg and Riisgard 1979). These rates at maximum capacity and 10-13°C were related to dry tissue weight, W, by the equation:

$R, L \cdot h^{-1} = 6.00W^{0.75}$ (Mohlenberg and Riisgard 1979).

With the sizes of horse mussels used in our experiments (Appendix 1), that is a minimum of 1.405 to a maximum of 5.158 g dry weight, the expected range was R = 5-13 $L \cdot h^{-1}$, assuming temperature equivalency.

The experiments were set up with the expectation of three mussels pumping near maximum capacity, that is:

3 x ~10 $L \cdot h^{-1}$ = 30 L filtered in a 1-h long experiment.

Since flume volume = 205 L, then we expected:

30/205 x 100 = 14.6% change in seston concentration per hour.

This compares to control difference in blank runs without mussels of -4.2 to +10.9% (Appendix 7) and a mean difference of -0.25%. Unfortunately, during our experiments only three mussels opened sufficiently to be described as at maximum capacity (see Appendix 4), and only one or two mussels per experiment opened at all. It is easy to see that the pumping/filtration power of the mussels may have been insufficient to overcome the wide differences, both positive and negative, in blank runs of our experiment. Because of this variability in control C1-C2 results, the resolution power of the fluorometric method is limited to differences where >11% of seston per hour is taken up by the experimental mussels. Unfortunately, this invalidates all of our filtration data.

The primary cause of these difficulties, the reluctance of horse mussels to pump at all, or at maximum pump capacity, must be considered. Both during our experiments and in the culture tank, 20-

80% of the population did not initiate pumping when offered a suitable mixed microalgal diet. The majority of those pumping did so at much less than maximum capacity. This may have been partly caused by inadequacies in the culture methods, e.g.:

- severing byssus threads on capture and just before experimentation (corrected in the definitive and confirmation experiments); and
- inappropriate seston concentration and quality, e.g. as a result of back-flushing seawater lines.

Other possible explanations of the poor feeding responses include: intrinsic historical factors individual to each mussel, as well as seasonal factors. The most likely of the latter would be temperature (6-7°C in the stock tank) and the fact that seawater temperature increased during experimentation by 2-3°C. It is possible also that horse mussels do not grow much in winter, with consequent problems in feeding experiments.

Despite our difficulties with filtration rates, the corresponding data for exhalant siphon area provide valid data. Recently, Newell et al. (in prep.) have shown that the exhalant siphon area is inversely related to U and by 32 $cm \cdot s^{-1}$ has decreased to <20% of the maximum siphon area at 10 $cm \cdot s^{-1}$. Our results, derived slightly differently, show that horse mussels reduce their siphon areas to ~20% of the maximum possible by 55 $cm \cdot s^{-1}$. This suggests, but does not confirm, that horse mussels have a greater tolerance at higher velocities than blue mussels.

CONCLUSIONS

Our results presented here do not convincingly support the alternative hypothesis that flow is not inhibitory to initial feeding responses of horse mussels. Although one of the independent methods, exhalant siphon opening area, did support the alternative hypothesis, another method involving seston depletion measurement did not. We believe that it is due to our inability to provide satisfactory culture conditions for horse mussel feeding, and thus big enough differences between C1 and C2, to be within the resolving power of the fluorometric method used.

Consequently, we recommend that these experiments be repeated, perhaps in the summer. We propose also to investigate the factors influencing variability in fluorometric determination of chlorophyll a in our conditions and in ensuring experiments where C1 and C2 are within the resolution of this method.

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Table 1. Observed and predicted exhalant siphon area during definitive experiments with horse mussels. 0 = valves <2-3 cm apart.

Mussel #	Predicted exhalant siphon area, mm^2	Observed, maximum Experiment number							
		1	2	3	4	5	6	9	10
2617	99.18	50.28			20.95			62.85	
2619	82.31	37.71			62.85			62.85	
2622	95.51	0			0			50.28	
2592	65.31		62.85			62.85			
2612	73.47		0			0			
2628	65.05		0			0			
2591	121.87			0			0		20.95
2596	113.09			0			44.00		52.38
2608	104.98			109.99			62.85		83.80

Table 2. Predicted maximum exhalant siphon area and that observed (SA, as a percentage of the maximum predicted) during confirmatory experiments with horse mussels and concomitant R, in $L \cdot h^{-1}$.

Mussel #	Predicted exhalant area, mm^2	Experiment number											
		1		2		3		4		5		6	
		SA	R	SA	R	SA	R	SA	R	SA	R	SA	R
2598	103.42	37	4.8									19	2.9
2606	92.04	0	0									0	0
2602	95.61	44	5.4									8	1.2
2616	84.76			0	0			0	0				
2595	90.64			14	0			5	0.9				
2609	81.09			0	0			47	7.7				
2630	73.63					57	3.3			38	3.2		
2618	98.27					0	0			0	0		
2627	82.83					0	0			0	0		

Table 3. Exhalant siphon area, SA, and filtration rate, R, in mussel #2608 during experiment 3.

U $cm \cdot s^{-1}$	Observed		Prediction by Møhlenberg & Riisgard		Prediction based on R
	SA, % max.	R, $L \cdot h^{-1}$	SA observed	SA 100%	SA 100%
14	12	5.1	1.5	12.1	42.5
18	57	6.4	6.8	12.1	11.2
23	88	15.7	10.6	12.1	17.8
27	75	16.5	9.0	12.1	22.0
33	56	10.7	6.7	12.1	19.1

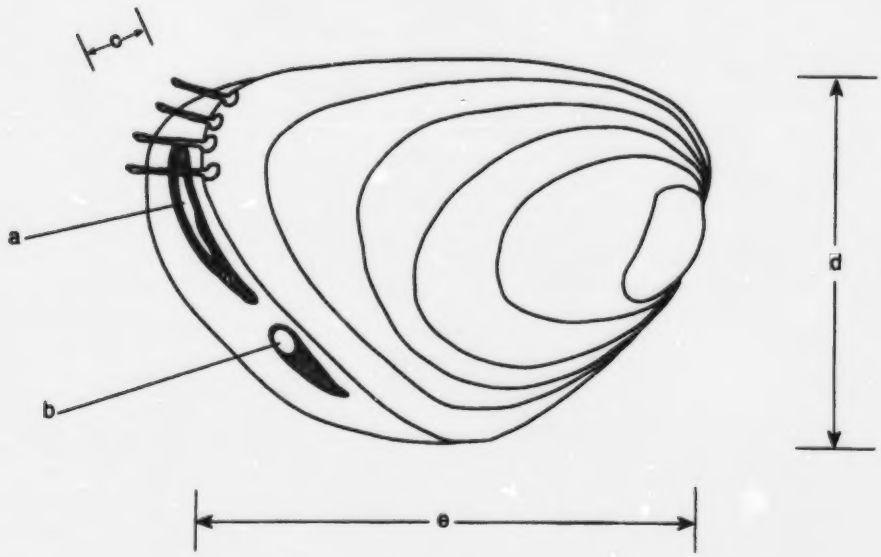

Fig. 1. Horse mussel #2630 as viewed in the holding/acclimation tank. a - inhalant siphon opening; b - exhalant siphon opening; c - valve gape; d - valve height; e - valve length.

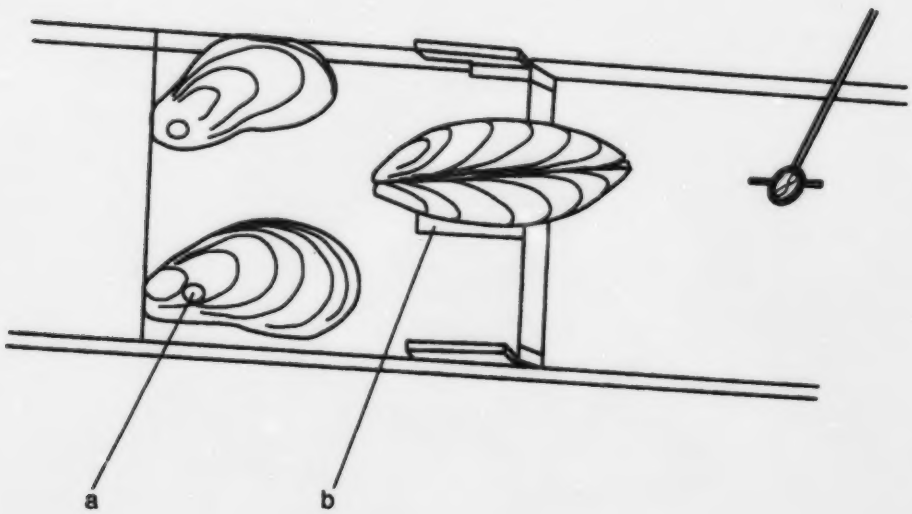

Fig. 2. Plate used in horse mussel experiments. a - numbered tag glued to left valve; b - Velcro strip glued to the plate.

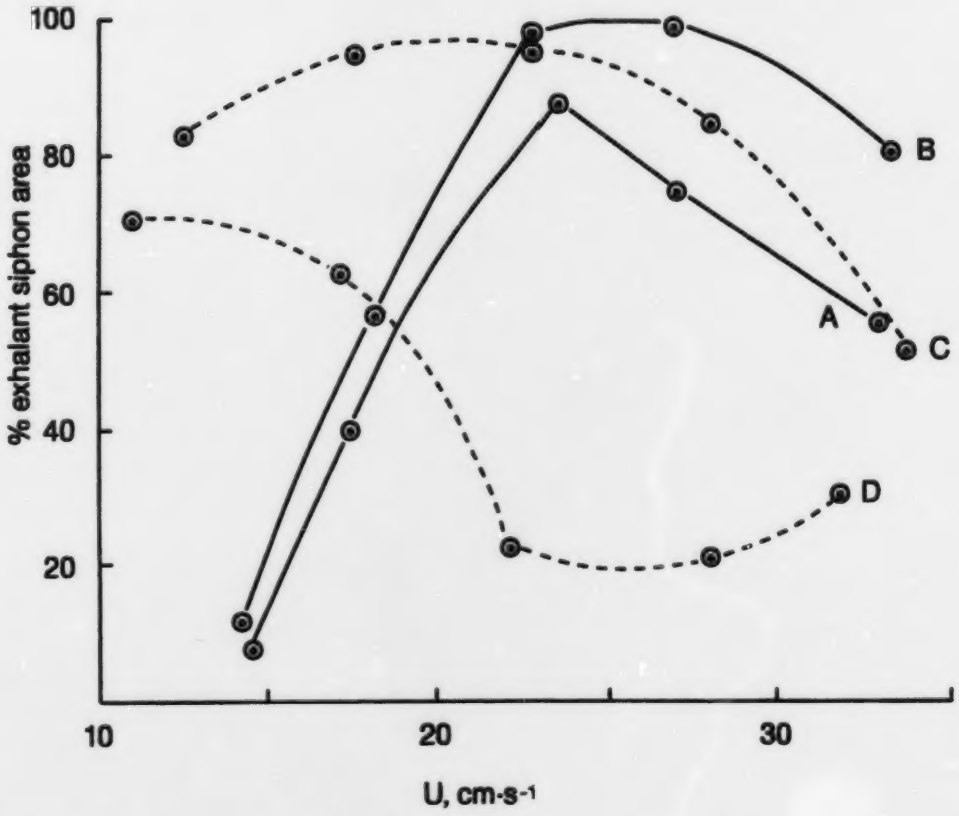

Fig. 3. Horse mussel exhalant siphon responses to changing velocity in the definitive experiment. A and B - increasing velocity; C and D - decreasing velocity. A - Expt. 2, #2592; B - Expt. #2608; C - Expt. 4, #2619; and D - Expt. 5, #2592.

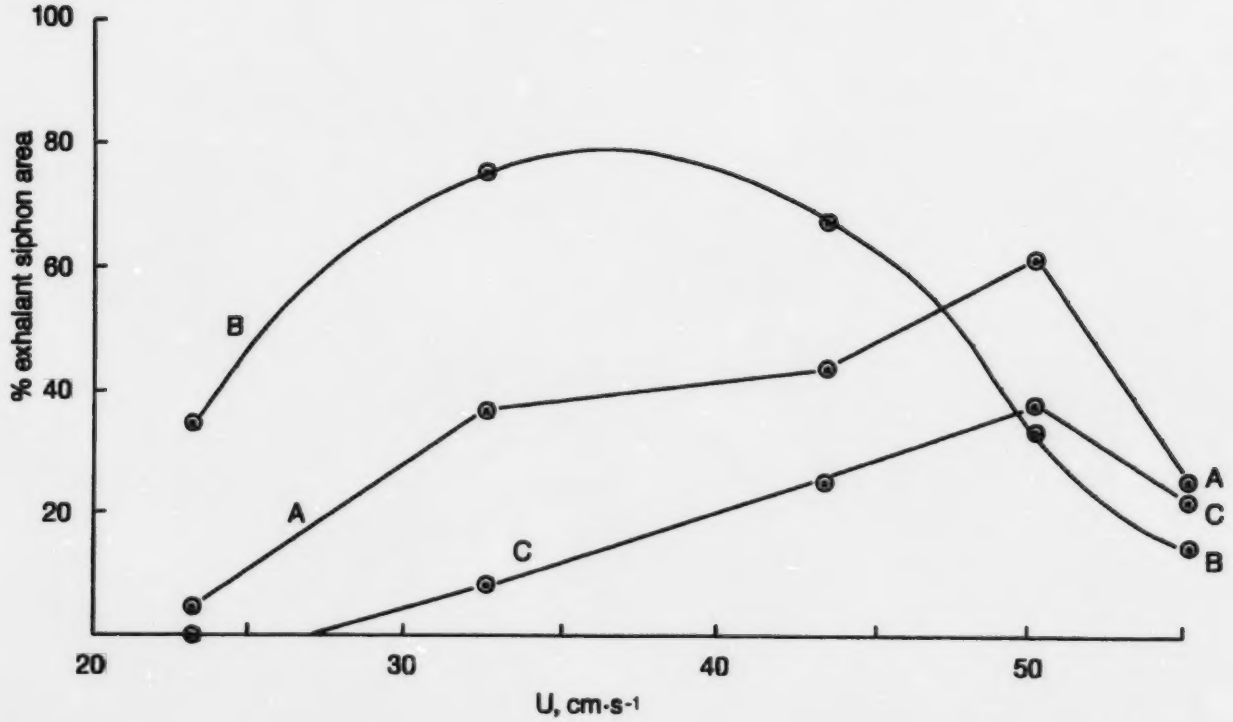

Fig. 4. Horse mussel exhalant siphon responses to changing velocity in the second part of the definitive experiment. All increasing velocities in experiment 9. A - #2617; B - #2619; C - #2622.

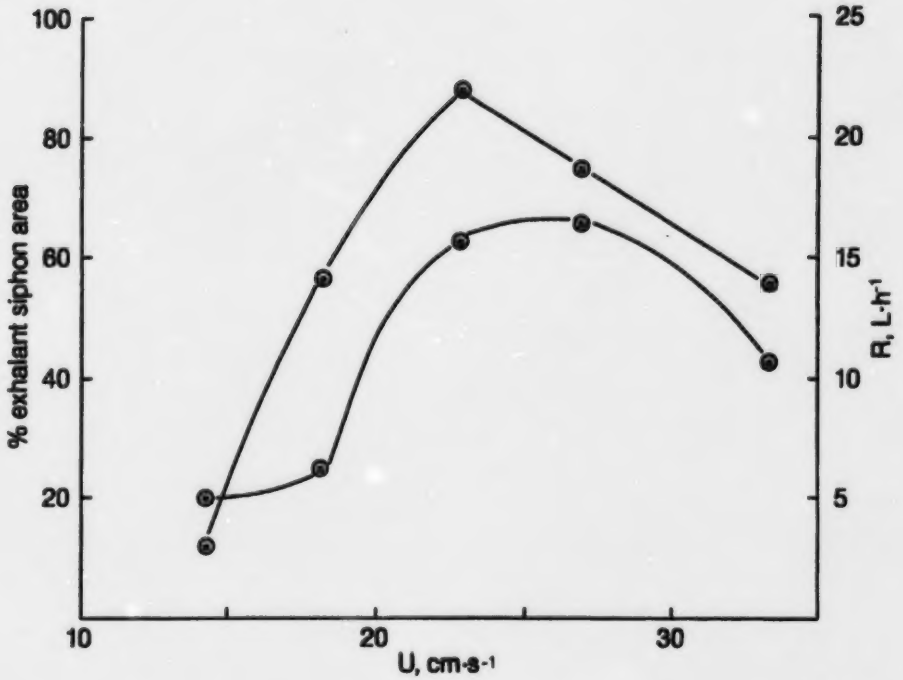

Fig. 5. Exhalant siphon responses and filtration rate, R, compared in experiment 3, mussel #2608.

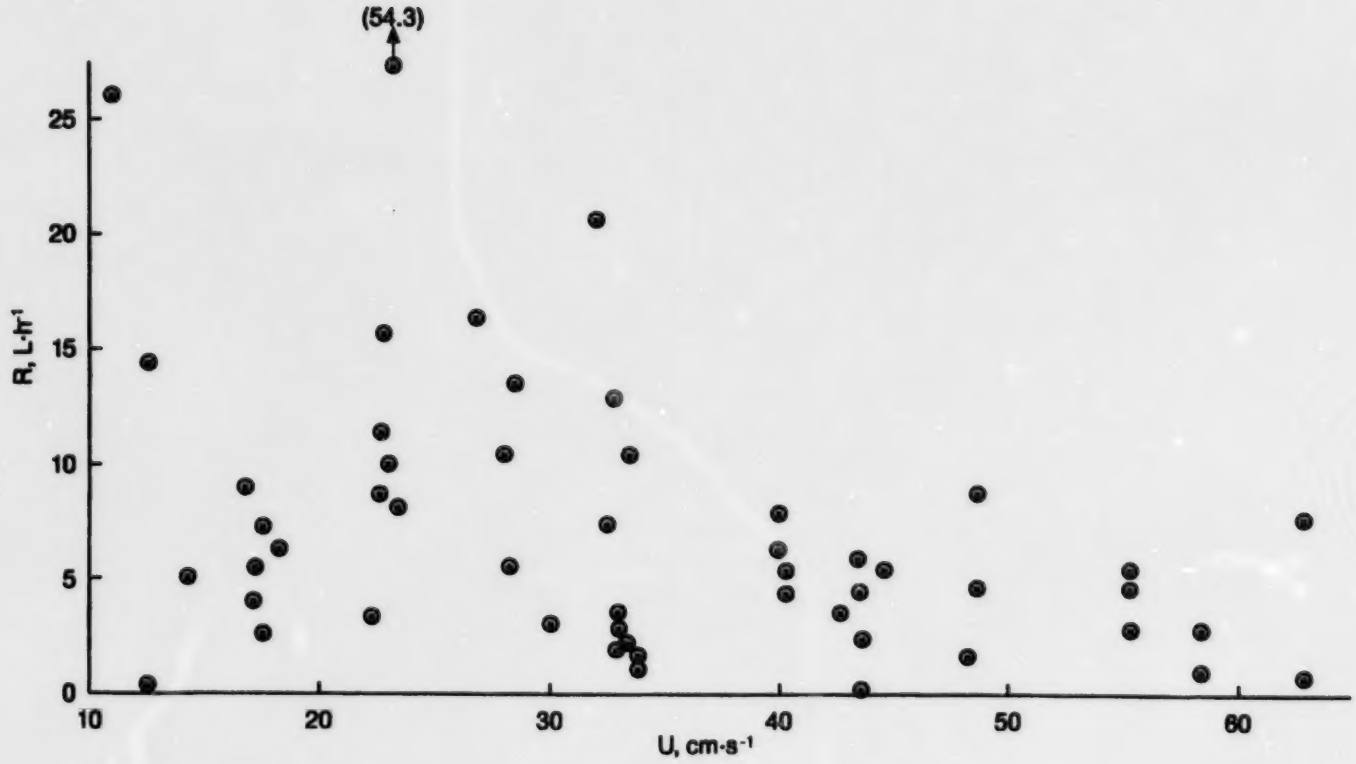

Fig. 6. Scatter diagram of all estimates of R in Appendices 4 and 6 on velocity, U.

Appendix 1. Biometry of Sandy Point horse mussels collected on 25.10.1999, determined on 06.03.2000.

Id #	Sex	Weights		Valve dimensions		
		Wet wt.	Dry wt.	Length	Height	Width
2591	M	23.8	4.14	89.5	50.6	34.12
2592	F	14.0	2.80	77.4	42.3	33.60
2593	M	8.5	1.72	61.8	34.2	23.04
2594	M	20.8	4.73	92.2	51.2	36.66
2595	F	19.4	3.88	87.0	45.1	36.53
2596	M	20.5	3.73	84.8	45.7	38.35
2597	M	18.5	3.57	90.7	48.2	35.68
2598	M	22.4	4.30	97.6	51.4	35.19
2599	M	22.9	4.61	87.9	44.3	40.32
2600	M	15.0	2.98	80.2	40.5	29.16
2601	M	11.3	2.17	67.1	39.5	28.26
2602	M	19.1	3.93	83.3	47.6	34.79
2603	F	15.9	2.87	82.7	44.0	34.22
2604	F	14.3	3.19	79.4	44.1	31.45
2605	M	13.4	2.86	71.1	39.1	31.99
2606	F	14.5	2.68	76.0	45.8	30.38
2607	F	23.0	4.59	93.8	49.3	38.91
2608	M	24.4	4.65	89.5	50.6	39.79
2609	M	11.6	2.41	66.5	40.4	32.24
2610	M	11.7	2.35	68.2	36.2	28.05
2611	M	26.2	5.16	93.2	51.8	42.01
2612	M	11.3	2.40	68.8	35.1	26.79
2614	M	20.2	4.12	84.6	45.1	34.41
2615	M	18.2	3.74	82.0	45.2	34.75
2616	M	18.2	3.62	77.1	42.2	33.44
2617	M	25.9	4.68	94.4	49.6	43.12
2618	F	22.0	4.34	87.9	48.9	38.75
2619	F	13.6	2.73	70.2	41.5	32.06
2620	M	15.5	3.07	85.1	43.6	35.96
2621	M	11.1	2.17	71.2	38.8	29.64
2622	M	18.4	3.43	83.9	47.7	37.23
2623	M	21.1	4.00	83.5	45.5	35.48
2624	M	19.0	3.89	82.7	45.2	34.82
2625	F	16.8	3.30	81.0	42.5	36.49
2626	M	19.4	3.85	87.5	45.2	37.09
2627	M	15.9	3.12	81.5	41.3	32.56
2628	M	6.6	1.41	55.4	32.0	23.31
2629	F	13.3	2.64	76.9	40.4	31.67
2630	M	8.1	1.47	69.9	36.7	27.24

Appendix 2. Behavioral data - opening/closing - in horse mussel experiments in the Saunders-Hubbard flume. F = exhalant measured, C = gape <3 mm.

Experiment number	Hour	Horse mussel number		
		2617	2619	2622
	1	2 C	3 F	1 C
	2	1 C	0 F	1 C
1	3	2 F	0 F	1 C
	4	1 F	0 F	2 C
	5	0 F	0 F	1 C
		2592	2612	2628
	1	2 C	0 C	0 C
	2	0 F	0 C	0 C
2	3	0 F	0 C	0 C
	4	0 F	0 C	0 C
	5	0 F	0 C	0C
		2591	2596	2608
	1	0 C	0 C	0 F
	2	3 C	2 C	0 F
3	3	0 C	2 C	0 F
	4	0 C	0 C	0 F
	5	1 C	2 C	2 F
		2617	2619	2622
	1	1 F	0 F	0 C
	2	1 F	0 F	0 C
4	3	0 F	0 F	2 C
	4	0 F	0 F	0 C
	5	2 F	0 F	0 C
		2592	2612	2628
	1	0 F	1 C	0 C
	2	0 F	2 C	0 C
5	3	0 F	2 C	0 C
	4	0 F	1 C	0 C
	5	0 F	0 C	0 C
		2591	2596	2608
	1	0 C	0 F	2 F
	2	2 C	0 F	0 F
6	3	0 C	0 F	0 F
	4	0 C	0 F	0 F
	5	0 C	4 F	0 F
		2617	2619	2622
	1	1 F	0 F	1 C
	2	0 F	0 F	0 F
9	3	0 F	0 F	3 F
	4	0 F	0 F	0 F
	5	1 F	2 F	0 F
		2591	2596	2608
	1	1 F	1 F	1 C
	2	0 F	1 F	0 F
10	3	0 C	3 F	0 F
	4	0 C	2 F	0 F
	5	0 C	1 F	1 F

Appendix 3 Gaping and exhalant siphon area observations in the definitive experiments.

EXPERIMENT 1

				2617			2619			2622		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1135	8.10	19.00		0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00
	8.10	19.00		0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00
	8.20	18.00		0.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00
	8.20	18.00		0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
	8.30	18.00		1.00	0.00	0.00	3.00	3.00	6.28	0.00	0.00	0.00
	8.30	17.00		1.00	0.00	0.00	3.00	3.00	6.28	2.00	0.00	0.00
				2.00	0.00	0.00	5.00	3.00	6.28	2.00	0.00	0.00
	8.40	18.00		3.00	0.00	0.00	5.00	3.00	6.28	2.00	0.00	0.00
	8.40	18.00		3.00	0.00	0.00	5.00	0.00	0.00	2.00	0.00	0.00
	8.50	17.00		0.00	0.00	0.00	5.00	3.00	6.28	2.00	0.00	0.00
	8.50	17.00		0.00	0.00	0.00	7.00	6.00	12.56	2.00	0.00	0.00
1230	8.50	18.00		0.00	0.00	0.00	7.00	1.00	2.09	2.00	0.00	0.00
Avg=	8.32	17.91	**14.46**		TTL=	0.00		TTL=	46.05		TTL=	0.00
S.D.=	0.15	0.70		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1235	8.60	25.00		0.00	0.00	0.00	7.00	3.00	6.28	0.00	0.00	0.00
	8.60	24.00		0.00	0.00	0.00	7.00	8.00	16.75	0.00	0.00	0.00
	8.60	24.00		0.00	0.00	0.00	7.00	10.00	20.93	0.00	0.00	0.00
	8.70	24.00		0.00	0.00	0.00	7.00	10.00	20.93	0.00	0.00	0.00
	8.70	23.00		0.00	0.00	0.00	7.00	15.00	31.40	0.00	0.00	0.00
	8.70	24.00		2.00	0.00	0.00	7.00	15.00	31.40	0.00	0.00	0.00
	8.80	24.00		2.00	0.00	0.00	7.00	15.00	31.40	0.00	0.00	0.00
	8.80	25.00		3.00	0.00	0.00	7.00	15.00	31.40	3.00	0.00	0.00
	9.00	25.00		3.00	0.00	0.00	7.00	15.00	31.40	2.00	0.00	0.00
	9.00	24.00		3.00	0.00	0.00	7.00	15.00	31.40	2.00	0.00	0.00
	9.00	24.00		3.00	0.00	0.00	7.00	15.00	31.40	2.00	0.00	0.00
1330	9.10	24.00		3.00	0.00	0.00	7.00	15.00	31.40	1.00	0.00	0.00
Avg=	8.80	24.17	**17.54**		TTL=	0.00		TTL=	316.09		TTL=	0.00
S.D.=	0.18	0.58		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1335	9.10	34.00		1.00	0.00	0.00	7.00	15.00	31.40	0.00	0.00	0.00
	9.20	35.00		0.00	0.00	0.00	7.00	15.00	31.40	0.00	0.00	0.00
	9.20	34.00		3.00	5.00	10.47	7.00	15.00	31.40	0.00	0.00	0.00
	9.30	34.00		3.00	5.00	10.47	7.00	15.00	31.40	0.00	0.00	0.00
	9.30	36.00		3.00	5.00	10.47	7.00	15.00	31.40	0.00	0.00	0.00
	9.30	34.00		3.00	5.00	10.47	7.00	15.00	31.40	0.00	0.00	0.00
	9.40	33.00		3.00	5.00	10.47	7.00	15.00	31.40	0.00	0.00	0.00
	9.50	35.00		3.00	5.00	10.47	7.00	15.00	31.40	0.00	0.00	0.00
	9.50	34.00		3.00	5.00	10.47	7.00	15.00	31.40	0.00	0.00	0.00
	9.50	35.00		5.00	5.00	10.47	7.00	15.00	31.40	0.00	0.00	0.00
	9.60	34.00		5.00	5.00	10.47	7.00	18.00	37.68	1.00	0.00	0.00
1430	9.60	34.00		5.00	5.00	10.47	7.00	18.00	37.68	1.00	0.00	0.00
Avg=	9.38	34.33	**22.54**		TTL=	104.67		TTL=	389.36		TTL=	0.00
S.D.=	0.17	0.78		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1435	9.60	48.00		0.00	0.00	0.00	7.00	15.00	31.40	0.00	0.00	0.00
	9.70	48.00		3.00	3.00	6.28	7.00	15.00	31.40	0.00	0.00	0.00
	9.70	48.00		5.00	3.00	6.28	7.00	10.00	20.93	0.00	0.00	0.00
	9.70	49.00		5.00	10.00	20.93	7.00	10.00	20.93	0.00	0.00	0.00
	9.80	47.00		5.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	9.80	47.00		5.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00

				2617			2619			2622		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
	9.80	47.00		6.00	6.00	12.56	7.00	10.00	20.93	0.00	0.00	0.00
	9.90	50.00		5.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	9.90	47.00		5.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	10.00	47.00		5.00	10.00	20.93	7.00	10.00	20.93	1.00	0.00	0.00
	10.00	48.00		5.00	20.00	41.87	7.00	10.00	20.93	1.00	0.00	0.00
1530	10.10	47.00		5.00	20.00	41.87	7.00	10.00	20.93	0.00	0.00	0.00
Avg=	9.83	47.75	**29.15**		TTL=	192.59		TTL=	272.13		TTL=	0.00
S.D.=	0.15	0.97		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1535	10.10	55.00		5.00	24.00	50.24	7.00	10.00	20.93	0.00	0.00	0.00
	10.10	55.00		5.00	20.00	41.87	7.00	2.00	4.19	1.00	0.00	0.00
	10.20	56.00		5.00	24.00	50.24	7.00	10.00	20.93	1.00	0.00	0.00
	10.20	56.00		5.00	24.00	50.24	7.00	10.00	20.93	1.00	0.00	0.00
	10.30	55.00		5.00	20.00	41.87	7.00	10.00	20.93	1.00	0.00	0.00
	10.30	55.00		5.00	5.00	10.47	7.00	10.00	20.93	1.00	0.00	0.00
	10.40	56.00		5.00	20.00	41.87	7.00	8.00	16.75	1.00	0.00	0.00
	10.40	57.00		5.00	20.00	41.87	7.00	6.00	12.56	1.00	0.00	0.00
	10.40	58.00		5.00	20.00	41.87	7.00	10.00	20.93	1.00	0.00	0.00
	10.40	55.00		5.00	20.00	41.87	7.00	10.00	20.93	1.00	0.00	0.00
	10.50	55.00		5.00	20.00	41.87	7.00	10.00	20.93	1.00	0.00	0.00
1630	10.50	54.00		5.00	20.00	41.87	7.00	10.00	20.93	1.00	0.00	0.00
Avg=	10.32	55.58	**33.00**		TTL=	496.12		TTL=	221.89		TTL=	0.00
S.D.=	0.14	1.08										

EXPERIMENT 2

				2592			2612			2628		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1105	7.40	18.00		1.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
	7.40	18.00		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.40	17.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.50	18.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.50	19.00		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.60	19.00		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.70	19.00		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.70	18.00		2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.80	19.00		2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7.90	18.00		2.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
	7.90	20.00		3.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
1200	8.00	18.00		2.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
Avg=	7.65	18.42	**14.71**		TTL=	62.80	0.00	TTL=	0.00		TTL=	0.00
S.D.=	0.22	0.79		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1205	8.00	25.00		3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8.10	23.00		3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8.10	24.00		3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8.20	23.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.20	24.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.20	23.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.30	24.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.30	25.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.30	25.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.40	24.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00

				2592			2612			2628		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
	8.50	24.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
1300	8.50	25.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
Avg=	8.26	24.08	**17.50**		TTL=	565.20		TTL=	0.00		TTL=	0.00
S.D.=	0.16	0.79		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1305	8.50	35.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.60	35.00		3.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
				5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.70	38.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.70	35.00		6.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.70	36.00		6.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.80	38.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.80	36.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.90	36.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.90	38.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	8.90	36.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
1400	9.00	36.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
Avg=	8.77	36.27	**23.50**		TTL=	753.60		TTL=	0.00		TTL=	0.00
S.D.=	0.15	1.19		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1405	9.00	45.00		5.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
	9.00	43.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.10	41.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.10	42.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.10	42.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.10	44.00		7.00	40.00	83.73	0.00	0.00	0.00	0.00	0.00	0.00
	9.20	46.00		7.00	40.00	83.73	0.00	0.00	0.00	0.00	0.00	0.00
	9.20	43.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.20	43.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.30	44.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.30	44.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
1500	9.30	44.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
Avg=	9.16	43.42	**27.01**		TTL=	774.53		TTL=	0.00		TTL=	0.00
S.D.=	0.11	1.38		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1505	9.30	54.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.40	56.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.40	55.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.40	56.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.40	54.00		7.00	40.00	83.73	0.00	0.00	0.00	0.00	0.00	0.00
	9.50	57.00		7.00	40.00	83.73	0.00	0.00	0.00	0.00	0.00	0.00
	9.50	56.00		2.00	5.00	10.47	0.00	0.00	0.00	0.00	0.00	0.00
	9.50	57.00		5.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
	9.60	56.00		5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9.60	56.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.60	55.00		5.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
1600	9.60	54.00		5.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
Avg=	9.48	55.50	**32.06**		TTL=	638.47		TTL=	0.00		TTL=	0.00
S.D.=	0.10	1.09										

EXPERIMENT 3

				2591			2596			2608		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1130	7.00	17.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
1135	7.10	17.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
1140	7.10	16.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
1145	7.20	19.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
1150	7.20	17.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
1155	7.30	18.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
1200	7.30	18.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
1205	7.40	17.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
1210	7.40	19.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
1215	7.50	18.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	24.00	50.24
1220	7.50	16.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	24.00	50.24
1225	7.50	16.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	24.00	50.24
Avg=	7.29	17.33	**14.17**		TTL=	0.00		TTL=	0.00		TTL=	150.72
S.D.=	0.17	1.07		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1230	7.60	25.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	24.00	50.24
1235	7.60	26.00		0.00	0.00	0.00	1.00	0.00	0.00	3.00	24.00	50.24
1240	7.60	26.00		0.00	0.00	0.00	2.00	0.00	0.00	3.00	24.00	50.24
1245	7.70	26.00		0.00	0.00	0.00	2.00	0.00	0.00	3.00	30.00	62.80
1250	7.70	27.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
1255	7.80	26.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
1300	7.90	25.00		1.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
1305	7.90	25.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
1310	7.90	25.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
1315	8.00	24.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
1320	8.10	27.00		1.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
1325	8.10	25.00		1.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
Avg=	7.83	25.58	**18.24**		TTL=	0.00		TTL=	0.00		TTL=	715.92
S.D.=	0.19	0.90		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1330	8.20	38.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
1335	8.20	36.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	30.00	62.80
1340	8.30	35.00		0.00	0.00	0.00	2.00	0.00	0.00	4.00	45.00	94.20
1345	8.30	35.00		0.00	0.00	0.00	2.00	0.00	0.00	4.00	45.00	94.20
1350	8.40	35.00		0.00	0.00	0.00	2.00	0.00	0.00	4.00	45.00	94.20
1355	8.40	35.00		0.00	0.00	0.00	2.00	0.00	0.00	4.00	45.00	94.20
1400	8.40	36.00		0.00	0.00	0.00	2.00	0.00	0.00	5.00	45.00	94.20
1405	8.50	35.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	45.00	94.20
1410	8.50	34.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	45.00	94.20
1415	8.50	34.00		0.00	0.00	0.00	0.00	0.00	0.00	6.00	52.50	109.90
1420	8.60	33.00		0.00	0.00	0.00	0.00	0.00	0.00	6.00	52.50	109.90
1425	8.60	34.00		0.00	0.00	0.00	0.00	0.00	0.00	6.00	52.50	109.90
Avg=	8.41	35.00	**22.87**		TTL=	0.00		TTL=	0.00		TTL=	1114.70
S.D.=	0.14	1.28		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1430	8.70	45.00		0.00	0.00	0.00	0.00	0.00	0.00	6.00	52.50	109.90
1435	8.70			0.00	0.00	0.00	0.00	0.00	0.00	6.00	52.50	109.90
1440	8.70	47.00		0.00	0.00	0.00	0.00	0.00	0.00	6.00	52.50	109.90
1445	8.70	44.00		0.00	0.00	0.00	0.00	0.00	0.00	6.00	52.50	109.90
1450	8.80	44.00		0.00	0.00	0.00	0.00	0.00	0.00	6.00	40.00	83.73
1455	8.80	43.00		0.00	0.00	0.00	0.00	0.00	0.00	3.00	20.00	41.87
1500	8.80	43.00		0.00	0.00	0.00	0.00	0.00	0.00	4.00	30.00	62.80
1505	8.90	43.00		0.00	0.00	0.00	0.00	0.00	0.00	4.00	30.00	62.80
1510	8.90	40.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80

				2591			2596			2608		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1515	8.90	41.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
1520	9.00	44.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
1525	9.00	42.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
Avg=	8.83	43.27	**26.94**		TTL=	0.00		TTL=	0.00		TTL=	942.00
S.D.=	0.11	1.90		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1530	9.00	56.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
1535	9.10	55.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
1540	9.10	57.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
1545	9.10	55.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
1550	9.10	57.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
1555	9.20	52.00		0.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
1600	9.20	57.00		0.00	0.00	0.00	0.00	0.00	0.00	6.00	40.00	83.73
1605	9.30	60.00		0.00	0.00	0.00	1.00	0.00	0.00	6.00	40.00	83.73
1610	9.30	56.00		0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00
1615	9.40	58.00		1.00	0.00	0.00	2.00	0.00	0.00	3.00	30.00	62.80
1620	9.40	56.00		1.00	0.00	0.00	0.00	0.00	0.00	5.00	30.00	62.80
1625	9.50	58.00		1.00	0.00	0.00	0.00	0.00	0.00	4.00	16.00	33.49
Avg=	9.23	56.42	**33.41**		TTL=	0.00		TTL=	0.00		TTL=	703.36
S.D.=	0.15	1.98										

EXPERIMENT 4

				2617			2619			2622		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1135	7.90	59.00		0.00	0.00	0.00	3.00	5.00	10.47	0.00	0.00	0.00
	7.90	58.00		0.00	0.00	0.00	5.00	10.00	20.93	0.00	0.00	0.00
	8.00	57.00		3.00	5.00	10.47	5.00	10.00	20.93	0.00	0.00	0.00
	8.00	57.00		5.00	10.00	20.93	5.00	10.00	20.93	0.00	0.00	0.00
	8.10	57.00		5.00	0.00	0.00	7.00	10.00	20.93	0.00	0.00	0.00
	8.10	55.00		3.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	8.20	57.00		3.00	10.00	20.93	7.00	15.00	31.40	0.00	0.00	0.00
	8.20	56.00		3.00	10.00	20.93	7.00	15.00	31.40	0.00	0.00	0.00
	8.30	59.00		3.00	5.00	10.47	7.00	21.00	43.96	0.00	0.00	0.00
	8.30	57.00		3.00	10.00	20.93	7.00	12.00	25.12	0.00	0.00	0.00
	8.40	58.00		3.00	10.00	20.93	7.00	15.00	31.40	0.00	0.00	0.00
1230	8.40	57.00		3.00	5.00	10.47	7.00	12.00	25.12	0.00	0.00	0.00
Avg=	8.15	57.25	**33.82**		TTL=	146.53		TTL=	303.53		TTL=	0.00
S.D.=	0.18	1.14		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1235	8.40	49.00		0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
	8.50	45.00		0.00	0.00	0.00	7.00	5.00	10.47	0.00	0.00	0.00
	8.50	46.00		0.00	0.00	0.00	7.00	10.00	20.93	0.00	0.00	0.00
	8.60	44.00		0.00	0.00	0.00	7.00	10.00	20.93	0.00	0.00	0.00
	8.60	47.00		2.00	0.00	0.00	7.00	10.00	20.93	0.00	0.00	0.00
	8.70	44.00		3.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	8.70	46.00		3.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	8.70	44.00		4.00	8.00	16.75	7.00	10.00	20.93	0.00	0.00	0.00
	8.80	45.00		3.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	8.80	45.00		3.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	8.90	46.00		3.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
1330	8.90	45.00		3.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
Avg=	8.68	45.50	**28.04**		TTL=	79.55		TTL=	219.80		TTL=	0.00
S.D.=	0.16	1.45										

				2617			2619			2622		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1335	9.00	35.00		4.00	8.00	16.75	7.00	10.00	20.93	0.00	0.00	0.00
	9.00	36.00		3.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	9.00	34.00		4.00	8.00	16.75	7.00	10.00	20.93	0.00	0.00	0.00
	9.10	33.00		4.00	8.00	16.75	7.00	10.00	20.93	0.00	0.00	0.00
	9.10	35.00		3.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	9.10	35.00		4.00	8.00	16.75	7.00	10.00	20.93	0.00	0.00	0.00
	9.20	34.00		4.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	9.20	35.00		4.00	5.00	10.47	7.00	10.00	20.93	0.00	0.00	0.00
	9.20	34.00		2.00	0.00	0.00	7.00	15.00	31.40	0.00	0.00	0.00
	9.30	35.00		2.00	8.00	16.75	7.00	6.00	12.56	0.00	0.00	0.00
	9.30	35.00		3.00	10.00	20.93	7.00	3.00	6.28	0.00	0.00	0.00
1430	9.30	34.00		4.00	10.00	20.93	7.00	3.00	6.28	0.00	0.00	0.00
Avg=	9.15	34.58	**22.67**		TTL=	167.47		TTL=	223.99		TTL=	0.00
S.D.=	9.40	28.00		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1435	9.40	25.00		3.00	10.00	20.93	7.00	6.00	12.56	0.00	0.00	0.00
	9.40	25.00		4.00	10.00	20.93	7.00	18.00	37.68	0.00	0.00	0.00
				3.00	30.00		7.00	30.00	62.80	0.00	0.00	0.00
	9.50	24.00		3.00	10.00	20.93	8.00	30.00	62.80	0.00	0.00	0.00
	9.50	24.00		3.00	10.00	20.93	8.00	31.00	64.89	0.00	0.00	0.00
	9.50	25.00		3.00	10.00	20.93	8.00	31.00	64.89	0.00	0.00	0.00
	9.60	25.00		3.00	10.00	20.93	8.00	24.00	50.24	0.00	0.00	0.00
	9.60	23.00		3.00	10.00	20.93	8.00	24.00	50.24	0.00	0.00	0.00
	9.60	24.00		3.00	10.00	20.93	8.00	24.00	50.24	0.00	0.00	0.00
	9.70	24.00		3.00	10.00	20.93	7.00	24.00	50.24	0.00	0.00	0.00
	9.70	23.00		3.00	10.00	20.93	7.00	24.00	50.24	0.00	0.00	0.00
1530	9.70	23.00		3.00	10.00	20.93	7.00	30.00	62.80	0.00	0.00	0.00
Avg=	9.56	24.09	**17.50**		TTL=	230.27		TTL=	619.63		TTL=	0.00
S.D.=	0.11	0.83		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1535	9.70	12.00		3.00	0.00	0.00	7.00	30.00	62.80	0.00	0.00	0.00
	9.80	14.00		0.00	0.00	0.00	7.00	30.00	62.80	0.00	0.00	0.00
	9.80	13.00		2.00	0.00	0.00	7.00	30.00	62.80	0.00	0.00	0.00
	9.90	14.00		2.00	0.00	0.00	7.00	24.00	50.24	0.00	0.00	0.00
	9.90	13.00		3.00	5.00	10.47	7.00	24.00	50.24	0.00	0.00	0.00
	10.00	14.00		2.00	0.00	0.00	7.00	24.00	50.24	0.00	0.00	0.00
	10.00	14.00		2.00	0.00	0.00	7.00	20.00	41.87	0.00	0.00	0.00
	10.00	15.00		2.00	0.00	0.00	7.00	30.00	62.80	0.00	0.00	0.00
	10.10	14.00		2.00	0.00	0.00	7.00	30.00	62.80	0.00	0.00	0.00
	10.10	14.00		2.00	0.00	0.00	7.00	30.00	62.80	0.00	0.00	0.00
	10.20	14.00		2.00	0.00	0.00	7.00	30.00	62.80	0.00	0.00	0.00
1630	10.20	16.00		2.00	0.00	0.00	7.00	30.00	62.80	0.00	0.00	0.00
Avg=	9.98	13.92	**12.49**		TTL=	10.47		TTL=	694.99		TTL=	0.00
S.D.=	0.16	1.00										

EXPERIMENT 5

				2592			2612			2628		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1100	7.60	53.00		0.00	5.00	10.47	0.00	0.00	0.00	0.00	0.00	0.00
	7.70	52.00		2.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
	7.70	54.00		2.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
	7.80	54.00		2.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
	7.80	53.00		3.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
	7.90	55.00		5.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
	7.90	53.00		6.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
	8.00	53.00		6.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
	8.00	54.00		6.00	20.00	41.87	2.00	0.00	0.00	0.00	0.00	0.00
	8.10	54.00		6.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
	8.10	54.00		7.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
1200	8.10	52.00		7.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
Avg=	7.89	53.42	**31.94**		TTL=	429.13		TTL=	0.00		TTL=	0.00
S.D.=	0.17	0.90		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1205	8.20	45.00		7.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
	8.20	46.00		2.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
	8.30	46.00		3.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
	8.30	45.00		4.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	8.40	46.00		4.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	8.40	46.00		4.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	8.50	46.00		3.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
	8.50	44.00		4.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	8.60	46.00		4.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	8.70	47.00		4.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	8.70	46.00		4.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
1300	8.80	45.00		4.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
Avg=	8.47	45.67	**28.12**		TTL=	669.87		TTL=	0.00		TTL=	0.00
S.D.=	0.20	0.78		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1305	8.90	35.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	8.90	34.00		7.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	9.00	35.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	9.00	33.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	9.10	35.00		7.00	30.00	62.80	3.00	0.00	0.00	0.00	0.00	0.00
	9.10	33.00		7.00	30.00	62.80	3.00	0.00	0.00	0.00	0.00	0.00
	9.10	33.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	9.20	34.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	9.20	34.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.30	34.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.30	35.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
1400	9.30	33.00		7.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
Avg=	9.12	34.00	**22.38**		TTL=	753.60		TTL=	0.00		TTL=	0.00
S.D.=	0.15	0.85		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1405	9.40	28.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.40	25.00		7.00	30.00	62.80	0.00	0.00	0.00	0.00	0.00	0.00
	9.40	25.00		7.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	9.50	24.00		7.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	9.50	24.00		7.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	9.50	22.00		7.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	9.60	23.00		7.00	30.00	62.80	1.00	0.00	0.00	0.00	0.00	0.00
	9.60	24.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	9.70	23.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00

				2592			2612			2628		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
	9.70	24.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	9.70	21.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
1500	9.80	22.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
Avg=	9.57	23.75	**17.13**		TTL=	753.60		TTL=	0.00		TTL=	0.00
S.D.=	0.14	1.82		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1505	9.80	10.00		6.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
	9.80	11.00		6.00	20.00	41.87	1.00	0.00	0.00	0.00	0.00	0.00
	9.80	6.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	9.90	11.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	9.90	15.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	9.90	7.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	10.00			7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	10.00	11.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	10.00	15.00		7.00	30.00	62.80	2.00	0.00	0.00	0.00	0.00	0.00
	10.00			7.00	20.00	41.87	2.00	0.00	0.00	0.00	0.00	0.00
	10.10			7.00	20.00	41.87	2.00	0.00	0.00	0.00	0.00	0.00
1600	10.10			7.00	20.00	41.87	2.00	0.00	0.00	0.00	0.00	0.00
Avg=	9.94	10.75	**10.93**		TTL=	648.93		TTL=	0.00		TTL=	0.00
S.D.	0.11	3.24										

EXPERIMENT 6

				2608			2591			2596		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1105	7.90	58.00		0.00	0.00	0.00	10.00	0.00	0.00	3.00	20.00	41.87
	7.90	55.00		0.00	0.00	0.00	10.00	0.00	0.00	3.00	20.00	41.87
	8.00	54.00		0.00	0.00	0.00	10.00	0.00	0.00	3.00	20.00	41.87
	8.10	55.00		0.00	0.00	0.00	10.00	0.00	0.00	3.00	20.00	41.87
	8.10	54.00		0.00	0.00	0.00	7.00	6.00	12.56	2.00	0.00	0.00
	8.20	56.00		0.00	0.00	0.00	7.00	6.00	12.56	2.00	0.00	0.00
	8.20	55.00		0.00	0.00	0.00	8.00	6.00	12.56	3.00	20.00	41.87
	8.30	57.00		0.00	0.00	0.00	8.00	6.00	12.56	0.00	0.00	0.00
	8.30	56.00		0.00	0.00	0.00	8.00	6.00	12.56	2.00	0.00	0.00
	8.40	55.00		0.00	0.00	0.00	9.00	8.00	16.75	2.00	0.00	0.00
	8.40	56.00		0.00	0.00	0.00	9.00	10.00	20.93	2.00	0.00	0.00
1200	8.40	55.00		0.00	0.00	0.00	9.00	10.00	20.93	2.00	0.00	0.00
Avg=	8.18	55.50	**32.96**		TTL=	0.00		TTL=	121.41		TTL=	209.33
S.D.=	0.19	1.17		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1205	8.50	47.00		0.00	0.00	0.00	9.00	10.00	20.93	1.00	0.00	0.00
	8.50	44.00		0.00	0.00	0.00	9.00	10.00	20.93	2.00	0.00	0.00
	8.60	45.00		0.00	0.00	0.00	9.00	10.00	20.93	3.00	5.00	10.47
	8.60	45.00		0.00	0.00	0.00	9.00	10.00	20.93	3.00	5.00	10.47
	8.70	47.00		0.00	0.00	0.00	9.00	10.00	20.93	3.00	5.00	10.47
	8.70	47.00		1.00	0.00	0.00	9.00	10.00	20.93	3.00	5.00	10.47
	8.70	49.00		1.00	0.00	0.00	9.00	10.00	20.93	3.00	5.00	10.47
	8.70	47.00		1.00	0.00	0.00	9.00	10.00	20.93	3.00	5.00	10.47
	8.80	46.00		1.00	0.00	0.00	9.00	10.00	20.93	3.00	5.00	10.47
	8.80	45.00		0.00	0.00	0.00	9.00	10.00	20.93	4.00	5.00	10.47
	8.90	46.00		0.00	0.00	0.00	9.00	10.00	20.93	4.00	5.00	10.47
1300	9.00	47.00		0.00	0.00	0.00	9.00	10.00	20.93	4.00	5.00	10.47
Avg=	8.71	46.25	**28.41**		TTL=	0.00		TTL=	251.20		TTL=	104.67
S.D.=	0.15	1.36										

				2608			2591			2596		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1305	9.00	35.00		0.00	0.00	0.00	9.00	10.00	20.93	4.00	5.00	10.47
	9.10	36.00		0.00	0.00	0.00	9.00	10.00	20.93	4.00	5.00	10.47
	9.20	34.00		0.00	0.00	0.00	7.00	5.00	10.47	6.00	10.00	20.93
	9.20	36.00		0.00	0.00	0.00	8.00	5.00	10.47	5.00	10.00	20.93
	9.20	36.00		0.00	0.00	0.00	8.00	10.00	20.93	5.00	10.00	20.93
	9.30	34.00		0.00	0.00	0.00	10.00	14.00	29.31	7.00	10.00	20.93
	9.30	37.00		0.00	0.00	0.00	10.00	10.00	20.93	7.00	10.00	20.93
	9.40	38.00		0.00	0.00	0.00	10.00	10.00	20.93	7.00	10.00	20.93
	9.40	37.00		0.00	0.00	0.00	10.00	10.00	20.93	7.00	10.00	20.93
	9.40	36.00		0.00	0.00	0.00	10.00	10.00	20.93	7.00	10.00	20.93
	9.50	38.00		0.00	0.00	0.00	10.00	10.00	20.93	7.00	10.00	20.93
1400	9.50	36.00		0.00	0.00	0.00	10.00	10.00	20.93	7.00	10.00	20.93
Avg=	9.29	36.08	23.40		TTL=	0.00		TTL=	238.64		TTL=	230.27
S.D.=	0.16	1.31		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1405	9.50	22.00		0.00	0.00	0.00	10.00	10.00	20.93	7.00	10.00	20.93
	9.50	22.00		0.00	0.00	0.00	10.00	10.00	20.93	7.00	10.00	20.93
	9.60	23.00		0.00	0.00	0.00	10.00	14.00	29.31	8.00	10.00	20.93
	9.70	23.00		0.00	0.00	0.00	10.00	14.00	29.31	8.00	10.00	20.93
	9.70	22.00		0.00	0.00	0.00	10.00	14.00	29.31	8.00	10.00	20.93
	9.70	22.00		0.00	0.00	0.00	10.00	14.00	29.31	6.00		0.00
	9.70	24.00		0.00	0.00	0.00	10.00	14.00	29.31	6.00	7.00	14.65
	9.80	23.00		0.00	0.00	0.00	10.00	14.00	29.31	8.00	10.00	20.93
	9.80	22.00		0.00	0.00	0.00	10.00	21.00	43.96	8.00	10.00	20.93
	9.80	25.00		0.00	0.00	0.00	10.00	15.00	31.40	6.00	10.00	20.93
	9.90	23.00		0.00	0.00	0.00	12.00	15.00	31.40	6.00	10.00	20.93
1500	9.90	23.00		0.00	0.00	0.00	12.00	21.00	43.96	6.00	10.00	20.93
Avg=	9.72	22.83	16.88		TTL=	0.00		TTL=	368.43		TTL=	223.99
S.D.=	0.13	0.94		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1505	10.00	76.00		0.00	20.00	41.87	10.00	20.00	41.87	6.00	10.00	20.93
	10.00	77.00		0.00	14.00	29.31	0.00	0.00	0.00	6.00	10.00	20.93
	10.10	78.00		0.00	14.00	29.31	10.00	20.00	41.87	6.00	10.00	20.93
	10.10	76.00		0.00	14.00	29.31	10.00	16.00	33.49	6.00		0.00
	10.20	77.00		0.00	14.00	29.31	10.00	4.00	8.37	6.00	10.00	20.93
	10.20	76.00		0.00	14.00	29.31	10.00	1.00	2.09	6.00	10.00	20.93
	10.30	78.00		0.00	14.00	29.31	10.00	2.00	4.19	6.00	20.00	41.87
	10.30	75.00		0.00	14.00	29.31	10.00	4.00	8.37	6.00	20.00	41.87
	10.40	77.00		0.00	14.00	29.31	12.00	4.00	8.37	6.00	20.00	41.87
	10.40	81.00		0.00	14.00	29.31	0.00	0.00	0.00	6.00	20.00	41.87
	10.40	75.00		0.00	0.00	0.00	10.00	2.00	4.19	8.00	30.00	62.80
1600	10.50	80.00		0.00	0.00	0.00	10.00	4.00	8.37	8.00	30.00	62.80
Avg=	10.24	77.17	43.62		TTL=	305.63		TTL=	161.19		TTL=	397.73
S.D.	0.17	1.85										

EXPERIMENT 9

				2617			2619			2622		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1135	7.10	36.00		0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
	7.10	38.00		2.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
	7.10	35.00		2.00	0.00	0.00	5.00	7.00	14.65	0.00	0.00	0.00
	7.20	35.00		2.00	0.00	0.00	5.00	7.00	14.65	0.00	0.00	0.00
	7.20	37.00		2.00	0.00	0.00	5.00	14.00	29.31	0.00	0.00	0.00
	7.20	35.00		3.00	0.00	0.00	5.00	14.00	29.31	0.00	0.00	0.00
	7.30	36.00		3.00	0.00	0.00	5.00	14.00	29.31	0.00	0.00	0.00
	7.30	36.00		3.00	0.00	0.00	5.00	14.00	29.31	0.00	0.00	0.00
	7.30	36.00		3.00	0.00	0.00	5.00	21.00	43.96	2.00	0.00	0.00
	7.40	36.00		4.00	10.00	20.93	5.00	21.00	43.96	2.00	0.00	0.00
	7.40	37.00		4.00	10.00	20.93	5.00	21.00	43.96	2.00	0.00	0.00
1230	7.50	32.00		4.00	10.00	20.93	5.00	30.00	62.80	2.00	0.00	0.00
Avg=	7.26	35.75	**23.24**		TTL=	62.80		TTL=	341.21		TTL=	0.00
S.D.=	0.13	1.48		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1235	7.50	55.00		4.00	10.00	20.93	5.00	30.00	62.80	2.00	0.00	0.00
	7.60	56.00		5.00	20.00	41.87	5.00	30.00	62.80	2.00	0.00	0.00
	7.60	55.00		5.00	20.00	41.87	5.00	30.00	62.80	2.00	0.00	0.00
	7.60	55.00		5.00	20.00	41.87	5.00	30.00	62.80	2.00	0.00	0.00
	7.70	55.00		5.00	20.00	41.87	5.00	30.00	62.80	2.00	0.00	0.00
	7.70	55.00		5.00	20.00	41.87	5.00	30.00	62.80	2.00	0.00	0.00
	7.70	54.00		5.00	20.00	41.87	5.00	30.00	62.80	2.00	0.00	0.00
	7.80	55.00		5.00	20.00	41.87	5.00	30.00	62.80	2.00	0.00	0.00
	7.80	57.00		4.00	20.00	41.87	5.00	30.00	62.80	2.00	10.00	20.93
	7.90	55.00		5.00	20.00	41.87	5.00	30.00	62.80	2.00	10.00	20.93
	7.90	52.00		4.00	10.00	20.93	5.00	30.00	62.80	2.00	10.00	20.93
1330	7.90	55.00		4.00	10.00	20.93	5.00	30.00	62.80	3.00	20.00	41.87
Avg=	7.73	54.92	**32.67**		TTL=	439.60		TTL=	753.60		TTL=	104.67
S.D.=	0.14	1.16		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1335	7.90	77.00		1.00	0.00	0.00	5.00	30.00	62.80	0.00	0.00	0.00
	8.00	76.00		4.00	20.00	41.87	5.00	30.00	62.80	3.00	10.00	20.93
	8.10	74.00		4.00	20.00	41.87	5.00	20.00	41.87	3.00	10.00	20.93
	8.10	81.00		5.00	20.00	41.87	6.00	30.00	62.80	3.00	20.00	41.87
	8.20	78.00		5.00	20.00	41.87	6.00	30.00	62.80	4.00	24.00	50.24
	8.20	79.00		5.00	20.00	41.87	6.00	30.00	62.80	4.00	24.00	50.24
	8.20	75.00		5.00	20.00	41.87	6.00	30.00	62.80	4.00	24.00	50.24
	8.30	80.00		5.00	30.00	62.80	6.00	30.00	62.80	0.00	0.00	0.00
	8.30	76.00		5.00	30.00	62.80	6.00	30.00	62.80	2.00	0.00	0.00
	8.40	78.00		5.00	30.00	62.80	6.00	12.00	25.12	2.00	10.00	20.93
	8.40	77.00		5.00	20.00	41.87	6.00	18.00	37.68	2.00	10.00	20.93
1430	8.40	78.00		5.00	20.00	41.87	6.00	30.00	62.80	2.00	10.00	20.93
Avg=	8.21	77.42	**43.75**		TTL=	523.33		TTL=	669.87		TTL=	297.25
S.D.=	0.16	2.02		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1435	8.50	89.00		5.00	21.00	43.96	6.00	18.00	37.68	1.00	0.00	0.00
	8.50	92.00		5.00	30.00	62.80	6.00	12.00	25.12	2.00	10.00	20.93
	8.60	92.00		5.00	30.00	62.80	6.00	20.00	41.87	3.00	20.00	41.87
	8.60	92.00		5.00	30.00	62.80	6.00	20.00	41.87	3.00	20.00	41.87
	8.70	91.00		5.00	30.00	62.80	6.00	20.00	41.87	3.00	20.00	41.87
	8.70	90.00		5.00	30.00	62.80	6.00	10.00	20.93	3.00	20.00	41.87
	8.70	93.00		5.00	30.00	62.80	6.00	10.00	20.93	3.00	20.00	41.87
	8.80	91.00		5.00	30.00	62.80	6.00	10.00	20.93	3.00	20.00	41.87
	8.80	92.00		5.00	30.00	62.80	6.00	10.00	20.93	3.00	20.00	41.87

				2617			2619			2622		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
	8.90	92.00		5.00	30.00	62.80	6.00	10.00	20.93	3.00	20.00	41.87
	8.90	86.00		5.00	30.00	62.80	6.00	10.00	20.93	3.00	20.00	41.87
1530	9.00	90.00		5.00	30.00	62.80	6.00	10.00	20.93	3.00	20.00	41.87
Avg=	8.73	90.83	**50.35**		TTL=	734.76		TTL=	334.93		TTL=	439.60
S.D.=	0.16	1.90		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1535	9.00	105.00		5.00	20.00	41.87	2.00	0.00	0.00	1.00	0.00	0.00
	9.10	102.00		5.00	14.00	29.31	0.00	0.00	0.00	2.00	0.00	0.00
	9.10	103.00		5.00	14.00	29.31	0.00	0.00	0.00	2.00	0.00	0.00
	9.20	102.00		5.00	14.00	29.31	6.00	7.00	14.65	3.00	0.00	0.00
	9.20	104.00		5.00	14.00	29.31	6.00	10.00	20.93	2.00	10.00	20.93
	9.30	103.00		5.00	14.00	29.31	6.00	10.00	20.93	3.00	10.00	20.93
	9.30	98.00		5.00	14.00	29.31	6.00	10.00	20.93	3.00	10.00	20.93
	9.40	96.00		5.00	14.00	29.31	6.00	10.00	20.93	2.00	0.00	0.00
	9.40	97.00		5.00	14.00	29.31	6.00	7.00	14.65	3.00	24.00	50.24
	9.40	103.00		5.00	14.00	29.31	6.00	7.00	14.65	3.00	24.00	50.24
	9.50	98.00		0.00	0.00	0.00	6.00	5.00	10.47	5.00	24.00	50.24
1630	9.50	101.00		0.00	0.00	0.00	6.00	5.00	10.47	5.00	24.00	50.24
Avg=	9.28	101.00	**55.36**		TTL=	305.63		TTL=	148.63		TTL=	263.76
S.D.=	0.16	2.98										

EXPERIMENT 10

				2591			2596			2608		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1105	8.20	92.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8.20	84.00		0.00	0.00	0.00	6.00	10.00	20.93	1.00	0.00	0.00
	8.30	91.00		0.00	0.00	0.00	6.00	5.00	10.47	2.00	0.00	0.00
	8.40	91.00		0.00	0.00	0.00	6.00	5.00	10.47	2.00	0.00	0.00
	8.40	88.00		1.00	0.00	0.00	6.00	10.00	20.93	2.00	0.00	0.00
	8.50	90.00		1.00	0.00	0.00	6.00	10.00	20.93	2.00	0.00	0.00
	8.60	88.00		1.00	0.00	0.00	6.00	10.00	20.93	2.00	0.00	0.00
	8.60	91.00		2.00	0.00	0.00	6.00	5.00	10.47	2.00	0.00	0.00
	8.70	88.00		3.00	0.00	0.00	8.00	10.00	20.93	2.00	0.00	0.00
	8.70	92.00		3.00	0.00	0.00	8.00	7.00	14.65	2.00	0.00	0.00
	8.80	94.00		3.00	0.00	0.00	8.00	7.00	14.65	2.00	0.00	0.00
1200	8.80	88.00		3.00	5.00	10.47	8.00	7.00	14.65	2.00	0.00	0.00
Avg=	8.52	89.75	**49.82**		TTL=	10.47		TTL=	180.03		TTL=	0.00
S.D.=	0.22	2.67		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1205	8.90	88.00		3.00	10.00	20.93	8.00	7.00	14.65	2.00	0.00	0.00
	8.90	87.00		3.00	10.00	20.93	8.00	14.00	29.31	2.00	0.00	0.00
	9.00	90.00		3.00	5.00	10.47	8.00	14.00	29.31	2.00	0.00	0.00
	9.10	88.00		3.00	5.00	10.47	8.00	14.00	29.31	2.00	8.00	16.75
	9.10	88.00		3.00	5.00	10.47	8.00	14.00	29.31	2.00	7.00	14.65
	9.10	88.00		3.00	5.00	10.47	8.00	7.00	14.65	3.00	24.00	50.24
	9.20	89.00		3.00	5.00	10.47	8.00	7.00	14.65	3.00	24.00	50.24
	9.30	86.00		3.00	5.00	10.47	8.00	7.00	14.65	3.00	24.00	50.24
	9.30	88.00		3.00	5.00	10.47	8.00	5.00	10.47	3.00	24.00	50.24
	9.30	86.00		3.00	0.00	0.00	8.00	10.00	20.93	3.00	24.00	50.24
	9.40	86.00		3.00	0.00	0.00	0.00	0.00	0.00	3.00	24.00	50.24
1300	9.40	84.00		3.00	0.00	0.00	0.00	0.00	0.00	3.00	24.00	50.24
Avg=	9.17	87.33	**48.63**		TTL=	115.13		TTL=	207.24		TTL=	383.08
S.D.=	0.18	1.61										

				2591			2596			2608		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1305	9.50	80.00		3.00	0.00	0.00	0.00	0.00	0.00	3.00	20.00	41.87
	9.60	80.00		3.00	0.00	0.00	5.00	0.00	0.00	3.00	20.00	41.87
	9.60	79.00		3.00	0.00	0.00	5.00	0.00	0.00	3.00	20.00	41.87
	9.70	79.00		3.00	0.00	0.00	7.00	10.00	20.93	4.00	20.00	41.87
	9.70	78.00		3.00	0.00	0.00	10.00	25.00	52.33	5.00	20.00	41.87
	9.80	79.00		3.00	0.00	0.00	0.00	0.00	0.00	5.00	20.00	41.87
	9.80	83.00		3.00	0.00	0.00	0.00	0.00	0.00	5.00	20.00	41.87
	9.90	78.00		3.00	0.00	0.00	5.00	0.00	0.00	5.00	20.00	41.87
	9.90	81.00		3.00	0.00	0.00	5.00	5.00	10.47	5.00	20.00	41.87
	10.00	79.00		3.00	0.00	0.00	8.00	15.00	31.40	5.00	20.00	41.87
1400	10.00	79.00		3.00	0.00	0.00	10.00	25.00	52.33	5.00	20.00	41.87
Avg=	9.77	79.55	**44.80**		TTL=	0.00		TTL=	167.47		TTL=	460.53
S.D.=	0.17	1.44		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1405	10.00	74.00		2.00	0.00	0.00	0.00	0.00	0.00	5.00	20.00	41.87
	10.10	75.00		2.00	0.00	0.00	0.00	0.00	0.00	5.00	20.00	41.87
	10.10	74.00		2.00	0.00	0.00	0.00	0.00	0.00	5.00	20.00	41.87
	10.10	75.00		2.00	0.00	0.00	5.00	0.00	0.00	5.00	20.00	41.87
	10.20	74.00		2.00	0.00	0.00	7.00	0.00	0.00	5.00	20.00	41.87
	10.20	74.00		2.00	0.00	0.00	7.00	3.00	6.28	5.00	20.00	41.87
	10.20	73.00		2.00	0.00	0.00	10.00	4.00	8.37	5.00	20.00	41.87
	10.30	76.00		2.00	0.00	0.00	0.00	0.00	0.00	5.00	20.00	41.87
	10.30	79.00		2.00	0.00	0.00	0.00	0.00	0.00	6.00	30.00	62.80
	10.40	79.00		2.00	0.00	0.00	0.00	0.00	0.00	6.00	30.00	62.80
	10.40	76.00		2.00	0.00	0.00	0.00	0.00	0.00	6.00	40.00	83.73
1500	10.40	75.00		2.00	0.00	0.00	0.00	0.00	0.00	6.00	40.00	83.73
Avg=	10.23	75.33	**42.72**		TTL=	0.00		TTL=	14.65		TTL=	628.00
S.D.=	0.14	1.92		Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1505	10.50	69.00		2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	10.50	70.00		2.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
	10.50	72.00		2.00	0.00	0.00	0.00	0.00	0.00	2.00	10.00	20.93
	10.60	70.00		2.00	0.00	0.00	0.00	0.00	0.00	3.00	10.00	20.93
	10.60	67.00		2.00	0.00	0.00	5.00	5.00	10.47	3.00	10.00	20.93
	10.60	68.00		2.00	0.00	0.00	5.00	10.00	20.93	3.00	10.00	20.93
	10.70	71.00		2.00	0.00	0.00	7.00	5.00	10.47	3.00	20.00	41.87
	10.70	70.00		2.00	0.00	0.00	7.00	15.00	31.40	3.00	20.00	41.87
	10.70	70.00		2.00	0.00	0.00	7.00	15.00	31.40	3.00	10.00	20.93
	10.80	70.00		2.00	0.00	0.00	7.00	15.00	31.40	3.00	10.00	20.93
	10.80	68.00		2.00	0.00	0.00	7.00	15.00	31.40	3.00	10.00	20.93
1600	10.80	67.00		2.00	0.00	0.00	10.00	25.00	52.33	3.00	20.00	41.87
Avg=	10.65	69.33	**39.77**		TTL=	0.00		TTL=	219.80		TTL=	272.13
S.D.=	0.12	1.56										

Appendix 4. Exhalant siphon area (SA) and filtration rate (R) of active horse mussels in definitive experiments.

Date	Mussel #	Hour	Fluor'y	MicroAlgal Dens'y*10^3	SA		R
					mm^2	% max	$L.Hr^{-1}$
		1			0	0	
		2			0	0	
	2617	3			104.67	9	
		4			192.59	16	
#1		5			496.12	42	
18-Jan		1			46.05	5	
		2			316.09	32	
	2619	3			389.36	39	
		4			272.13	28	
		5			221.89	22	
	2622				0	0	
		1			62.80	8	
#2		2			565.20	40	
19-Jan	2592	3			753.60	96	
		4			774.53	99	
		5			638.47	81	
	2612				0	0	
	2628				0	0	
	2591				0	0	
	2596				0	0	
#3		1	903.0	10768.289	150.72	12	5.1
20-Jan		2	881.0	10505.873	715.92	57	6.4
	2608	3	854.0	10183.817	1114.70	88	15.7
		4	791.0	9432.3525	942.00	75	16.5
		5	730.0	8704.7445	703.36	56	10.7
		1	919.3	20933.629	146.53	12	1.2
		2	854.0	19449.164	79.55	7	0
	2617	3	839.0	19108.169	167.47	14	8.8
		4	867.7	19760.606	230.27	19	2.8
#4		5	785.0	17880.587	10.47	1	0.2
25-Jan		1	919.3	20933.629	303.53	31	2.4
		2	854.0	19449.164	219.80	22	0
	2619	3	839.0	19108.169	223.99	23	11.8
		4	867.7	19760.606	619.63	63	7.4
		5	785.0	17880.587	694.99	70	14.6
	2622				0	0	
		1	703.7	16032.394	429.13	55	20.8
		2	636.3	14500.19	669.87	85	10.6
	2592	3	604.3	13772.734	753.60	96	0
#5		4	604.0	13765.914	753.60	96	4.11
26-Jan		5	592.3	13499.938	648.93	83	26.2
	2612				0	0	
	2628				0	0	

Appendix 4. (cont'd)

				MicroAlgal	SA		R
Date	Mussel #	Hour	Fluor'y	Dens'y*10^3	mm^2	% max	$L.Hr^{-1}$
		1	751.0	17107.665	0	0	0
		2	729.3	16614.359	0	0	0
	2608	3	663.7	15123.074	0	0	0
		4	614.0	13993.244	0	0	0
		5	572.0	13038.458	305.63	24	4.7
		1	751	17107.665	121.41	8	2.2
		2	729.3	16614.359	251.20	17	13.6
#6	2591	3	663.7	15123.074	238.64	16	8.2
27-Jan		4	614	13993.244	368.43	25	9
		5	572	13038.458	161.19	11	2.5
		1	751	17107.665	209.33	15	3.9
		2	729.3	16614.359	104.67	8	5.6
	2596	3	663.7	15123.074	230.27	17	7.9
		4	614	13993.244	223.99	17	5.5
		5	572	13038.458	397.73	29	6.1
		1	650.33	8895.0763	62.80	5	10
		2	474.67	6522.9637	439.60	37	7.5
	2617	3	426.33	5870.1803	523.33	44	0
		4	463.33	6369.8283	734.76	62	0
		5	467	6419.388	305.63	26	5.6
		1	650.33	8895.0763	341.21	35	54.3
		2	474.67	6522.9637	753.60	76	13
#9	2619	3	426.33	5870.1803	669.87	68	0
14-Feb		4	463.33	6369.8283	334.93	34	0
		5	467	6419.388	148.63	15	2.8
		1	650.33	8895.0763	0	0	0
		2	474.67	6522.9637	104.67	9	1.8
	2622	3	426.33	5870.1803	297.25	26	0
		4	463.33	6369.8283	439.60	38	0
		5	467	6419.388	263.76	23	4.9
		1	762.33	10407.524	10.47	1	0
		2	882.33	12028.004	115.13	8	2.8
	2591	3	813.67	11100.82	0	0	0
		4	785.33	10718.116	0	0	0
		5	770	10511.1	0	0	0
		1	762.33	10407.524	180.03	13	0
		2	882.33	12028.004	207.24	15	4.8
#10	2596	3	813.67	11100.82	167.47	12	1.9
16-Feb		4	785.33	10718.116	14.65	1	0.1
		5	770	10511.1	219.80	16	6.4
		1	762.33	10407.524	0	0	0
		2	882.33	12028.004	383.08	30	8.9
	2608	3	813.67	11100.82	460.53	37	5.5
		4	785.33	10718.116	628.00	50	3.9
		5	770	10511.1	272.13	22	7.9

Appendix 5. Gaping and exhalant siphon area observations in the confirmatory equipment.

Experiment #1

				2598			2606			2602		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1325				0.00	0.00	0.00	1.00	0.00	0.00	3.00	10.00	20.93
30				0.00	0.00	0.00	1.00	0.00	0.00	3.00	10.00	20.93
35		72		3.00	10.00	20.93	1.00	0.00	0.00	3.00	20.00	41.87
40	9.0	71		3.00	10.00	20.93	1.00	0.00	0.00	3.00	20.00	41.87
45	9.0	72		3.00	10.00	20.93	1.00	0.00	0.00	4.00	20.00	41.87
50	9.1	72		3.00	10.00	20.93	1.00	0.00	0.00	4.00	20.00	41.87
55	9.1	73		3.00	20.00	41.87	1.00	0.00	0.00	4.00	20.00	41.87
1400	9.1	72		4.00	20.00	41.87	1.00	0.00	0.00	4.00	20.00	41.87
5	9.2	76		5.00	24.00	50.24	1.00	0.00	0.00	4.00	20.00	41.87
10	9.2	74		5.00	24.00	50.24	1.00	0.00	0.00	4.00	20.00	41.87
15	9.3	71		6.00	30.00	62.80	0.00	0.00	0.00	4.00	20.00	41.87
20	9.3	73		6.00	30.00	62.80	0.00	0.00	0.00	4.00	20.00	41.87
25	9.4	72		6.00	30.00	62.80	1.00	0.00	0.00	4.00	20.00	41.87
Avg=	9.17	72.55	**35.51**		TTL=	456.35		TTL=	0.00		TTL=	502.40
S.D.=	0.13	1.44										

Experiment #2

				2616			2595			2609		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1130	7.9	87		0.00	0.00	0.00	10.00	15.00	31.40	0.00	0.00	0.00
35	7.9	89		0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00
40	8.0	87		1.00	0.00	0.00	3.00	0.00	0.00	2.00	0.00	0.00
45	8.0	89		1.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00
50	8.1	91		2.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00
55	8.1	88		2.00	0.00		10.00	10.00	20.93	0.00	0.00	0.00
1200	8.2	91		2.00	0.00	0.00	10.00	16.00	33.49	0.00	0.00	0.00
5	8.2	91		2.00	0.00	0.00	7.00	0.00	0.00	2.00	0.00	0.00
10	8.3	89		1.00	0.00	0.00	7.00	0.00	0.00	0.00	0.00	0.00
15	8.3	89		1.00	0.00	0.00	8.00	10.00	20.93	0.00	0.00	0.00
20	8.4	90		1.00	0.00	0.00	10.00	10.00	20.93	3.00	0.00	0.00
25	8.4	89		1.00	0.00	0.00	10.00	10.00	20.93	2.00	0.00	0.00
30	8.5	94		1.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00
Avg=	8.18	89.54	**49.71**		TTL=	0.00		TTL=	148.63		TTL=	0.00
S.D.=	0.20	1.90										

Experiment #3

				2630			2618			2627		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1115	6.8	38		6.00	12.00	25.12	0.00	0.00	0.00	0.00	0.00	0.00
20	6.9	39		6.00	12.00	25.12	0.00	0.00	0.00	0.00	0.00	0.00
25	6.9	39		6.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
30	7.0	38		6.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
35	7.0	40		6.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
40	7.0	39		6.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
45	7.1	39		6.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
50	7.1	38		6.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
55	7.1	37		6.00	20.00	41.87	0.00	0.00	0.00	1.00	0.00	0.00
1200	7.2	38		6.00	20.00	41.87	0.00	0.00	0.00	1.00	0.00	0.00
5	7.2	40		6.00	15.00	31.40	0.00	0.00	0.00	1.00	0.00	0.00

				2630			2618			2627		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
10	7.3	38		6.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
15	7.3	39		6.00	20.00	41.87	0.00	0.00	0.00	0.00	0.00	0.00
Avg=	7.07	38.62	**24.65**		TTL=	500.31		TTL=	0.00		TTL=	0.00
S.D.=	0.15	0.87										

Experiment #4

				2595			2616			2609		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1405	9.0	117		1.00	0.00	0.00	2.00	0.00	0.00	6.00	10.00	20.93
10	9.1	115		2.00	0.00	0.00	2.00	0.00	0.00	3.00	10.00	20.93
15	9.1	118		2.00	0.00	0.00	5.00	0.00	0.00	3.00	20.00	41.87
20	9.2	118		0.00	0.00	0.00	0.00	0.00	0.00	2.00	20.00	41.87
25	9.2	117		0.00	0.00	0.00	0.00	0.00	0.00	2.00	20.00	41.87
30	9.2	116		0.00	0.00	0.00	0.00	0.00	0.00	2.00	20.00	41.87
35	9.3	117		1.00	0.00	0.00	2.00	0.00	0.00	4.00	20.00	41.87
40	9.3	115		2.00	0.00	0.00	2.00	0.00	0.00	4.00	20.00	41.87
45	9.3	114		2.00	0.00	0.00	2.00	0.00	0.00	4.00	20.00	41.87
50	9.4	115		1.00	10.00	20.93	1.00	0.00	0.00	4.00	20.00	41.87
55	9.4	115		2.00	8.00	16.75	3.00	0.00	0.00	2.00	20.00	41.87
1500	9.5	119		2.00	8.00	16.75	3.00	0.00	0.00	4.00	20.00	41.87
Avg=	9.25	116.33	**62.90**		TTL=	54.43		TTL=	0.00		TTL=	460.53
S.D.=	0.14	1.56										

Experiment #5

				2630			2618			2627		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1430	9.3	49		4.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
35	9.3	51		4.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
40	9.3	51		4.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
45	9.4	47		4.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
50	9.4	50		4.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
55	9.4	50		4.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
1500	9.5	51		4.00	10.00	20.93	0.00	0.00	0.00	0.00	0.00	0.00
5	9.5	51		4.00	10.00	20.93	3.00	0.00	0.00	0.00	0.00	0.00
10	9.6	48		4.00	20.00	41.87	3.00	0.00	0.00	0.00	0.00	0.00
15	9.6	50		4.00	20.00	41.87	0.00	0.00	0.00	1.00	0.00	0.00
20	9.6	50		4.00	20.00	41.87	0.00	0.00	0.00	1.00	0.00	0.00
25	9.7	49		4.00	20.00	41.87	0.00	0.00	0.00	1.00	0.00	0.00
30	8.5	50		4.00	10.00	20.93	0.00	0.00	0.00	1.00	0.00	0.00
Avg=	9.39	49.77	**30.14**		TTL=	334.93		TTL=	0.00		TTL=	0.00
S.D.=	0.30	1.24										

Experiment #6

				2598			2606			2602		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
1105	7.2	109		0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
10	7.2	110		0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
15	7.3	109		8.00	10.00	20.93	0.00	0.00	0.00	1.00	0.00	0.00
20	7.3	106		6.00	10.00	20.93	1.00	0.00	0.00	1.00	0.00	0.00
25	7.4	108		5.00	10.00	20.93	1.00	0.00	0.00	1.00	0.00	0.00
30	7.5	106		5.00	10.00	20.93	0.00	0.00	0.00	2.00	0.00	0.00

				2598			2606			2602		
Time	Temp	Hz	cps	Gape	w*ht	Area	Gape	w*ht	Area	Gape	w*ht	Area
35	7.5	104		5.00	10.00	20.93	1.00	0.00	0.00	3.00	5.00	10.47
40	7.5	107		7.00	20.00	41.87	1.00	0.00	0.00	2.00	0.00	0.00
45	7.6	106		6.00	10.00	20.93	1.00	0.00	0.00	3.00	10.00	20.93
50	7.7	108	pvm	7.00	10.00	20.93	0.00	0.00	0.00	3.00	10.00	20.93
55	7.7	110	58.68	7.00	10.00	20.93	0.00	0.00	0.00	3.00	10.00	20.93
1200	7.8	110	power	7.00	10.00	20.93	0.00	0.00	0.00	3.00	10.00	20.93
Avg=	7.48	107.75	**44.18**		TTL=	230.27		TTL=	0.00		TTL=	94.20
S.D.=	0.20	1.96										

Appendix 6. Exhalant siphon area (SA) and filtration rate (R) of active horse mussels in confirmatory experiments.

Date	Mussel #	Fluor'y	MicroAlgal density	SA		R
				mm^2	% max	$L.Hr^{-1}$
#1	2598	473.2	6503.1128	456.35	37	4.8
28-Feb	2606	473.2	6503.1128	0	0	0
	2602	473.2	6503.1128	502.4	44	5.4
#2	2616	524.4	7194.5176	0	0	0
29-Feb	2595	524.4	7194.5176	148.63	14	0
	26.9	524.4	7194.5176	0	0	0
#3	2630	753.6	10289.6340	500.31	57	3.3
3-Mar	2618	753.6	10289.6340	0	0	0
	2627	753.6	10289.6340	0	0	0
#4	2595	783.2	10689.3530	54.43	5	0.9
2-Mar	2616	783.2	10689.3530	0	0	0
	2609	783.2	10689.3530	460.53	47	7.7
#5	2630	577.0	7904.8280	334.93	38	3.2
29-Feb	2618	577.0	7904.8280	0	0	0
	2627	577.0	7904.8280	0	0	0
#6	2598	758.4	10354.4540	230.27	19	2.9
2-Mar	2606	578.4	7923.7336	0	0	0
	2602	578.4	7923.7336	94.20	8	1.2

Appendix 7. Filtration rate , R_{blank}, measured in control runs of definitive, D, and confirmatory, C, experimentes.

Exp # Date	Hour	Fluor'y	Density	Temperature		u(cm/sec)	R-blank $L.hr^{-1}$
				Mean	S.D.		
	1	538	7378.1720	8.8	0.1	14.90	10.6
D7	2	511	7013.5640	9.2	0.1	19.39	-10.8
1-Feb	3	538.7	7387.6248	9.7	0.2	25.84	5.8
	4	524.3	7193.1672	10.2	0.1	30.60	2
	5	519	7121.5960	10.5	0.1	34.28	4.9
	1	518.3	7112.1432	7.4	0.2	31.53	0.8
D8	2	515.7	7077.0328	8.1	0.2	26.20	-2.8
2-Feb	3	522.7	7171.5608	8.5	0.1	22.82	4.4
	4	512	7027.0680	8.9	0.1	19.13	5.3
	5	499	6851.5160	9.2	0.1	15.17	8.8
	1	511	7013.5640	7.1	0.1	23.93	3.6
D11	2	501.67	6887.5717	7.6	0.2	30.45	-7.2
25-Feb	3	519.67	7130.6437	8.1	0.2	37.29	7.6
	4	500.67	6874.0677	8.7	0.2	40.73	3.7
	5	492	6756.9880	9.3	0.2	45.15	-10.2
C7(Mar-3)	1			7.5	0.1	25.45	6.6
C8(Feb-28)	1			9.7	0.2	35.23	21.5

Appendix 8. Microalgal stock cell densities used in definitive (D) and confirmatory (C) experiments.

Experiment #	*Isochrysis* sp. TISO x 10^6 cells·mL^{-1}	*Chaetoceros calcitrans* x 10^6 cells·mL^{-1}
D1		
D2	1.095	2.609
D3	1.370	2.609
D4		
D5		
D6	1.605	2.0433
D7		
D8		
C1		
C2		
C3	0.5483	1.9067
C4		
C5		
C6		